A Technology Transfer Cocktail - Focussing on the Internet & e-Commerce

VMR 2001: Thursday 17th May 2001 in the Museum Suite
at the Copthorne Effingham Park Hotel – Gatwick

Professor Chris R. Chatwin –
Technology Hub Research Director

School of Engineering & Information Technology
University of Sussex

Technology Hub

This is Part of the Team I Have

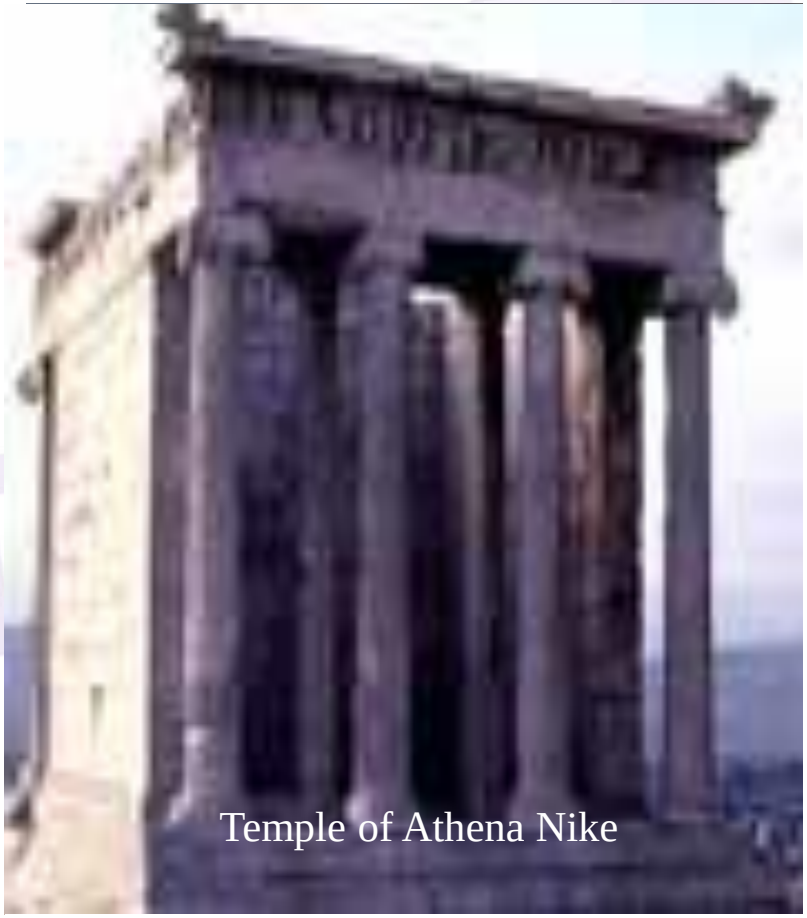
Technology Hub

Cocktail Ingredients

- The Players in Technology Creation & Exploitation
- Micro-Engineering & manufacturing
- Micro-manufacture and the Internet
- Image Processing & Photonics
- Time Compression and Rapid Prototyping
- Internet Data Comms. & e-commerce

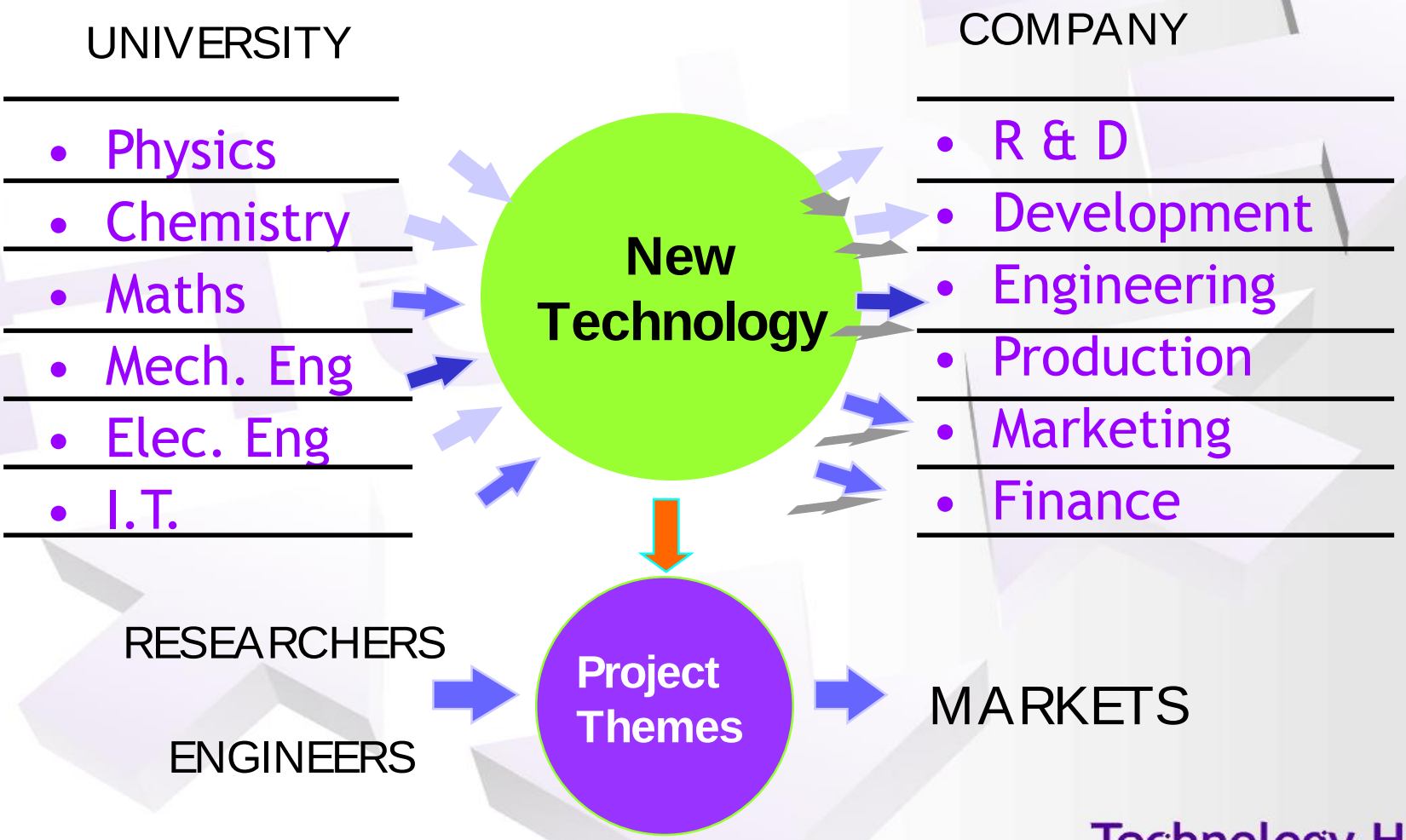
Technology Hub

There is Wealth in those University Ivory Towers

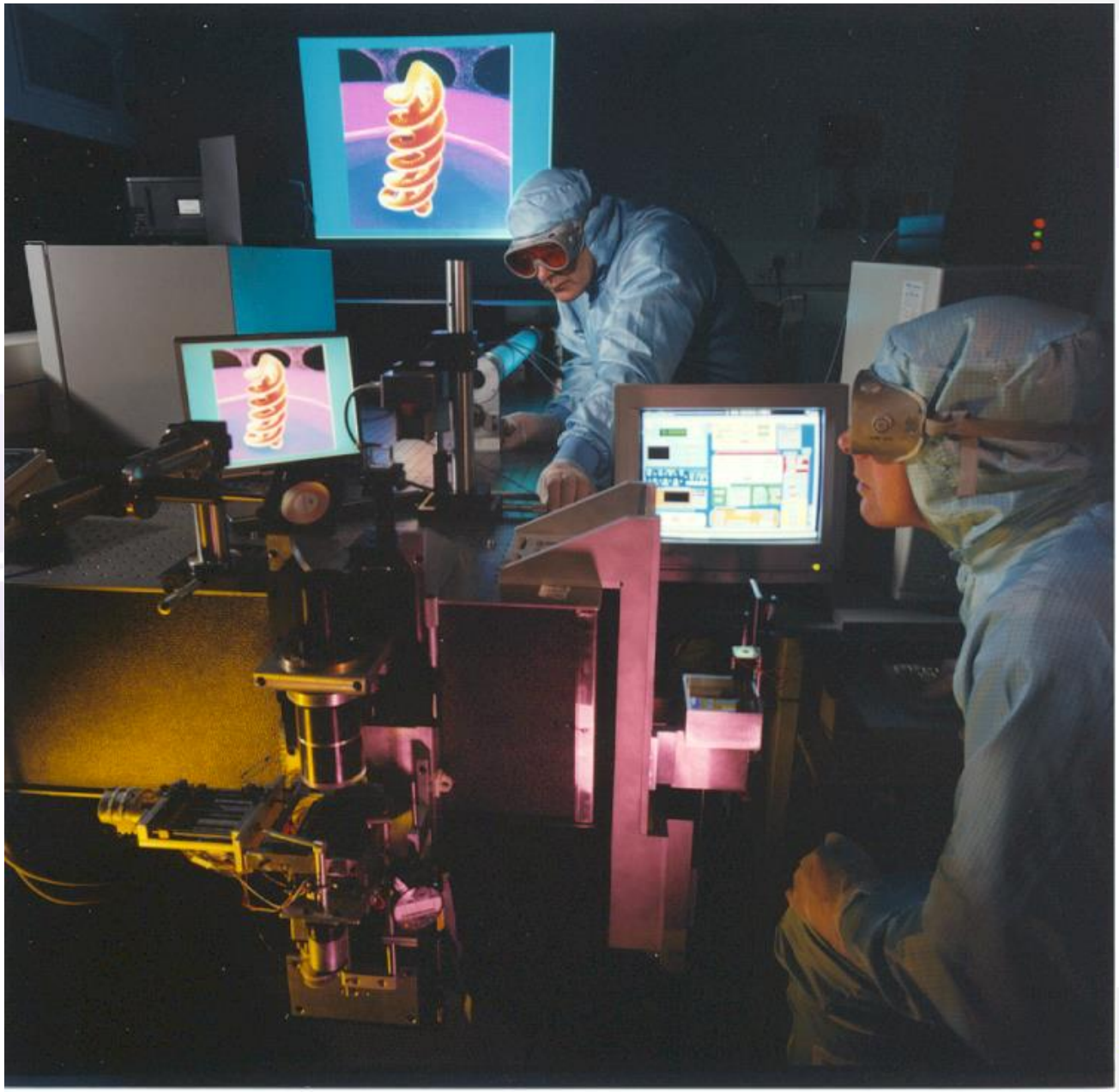

Temple of Athena Nike

Technology Hub

Breaking down the barriers



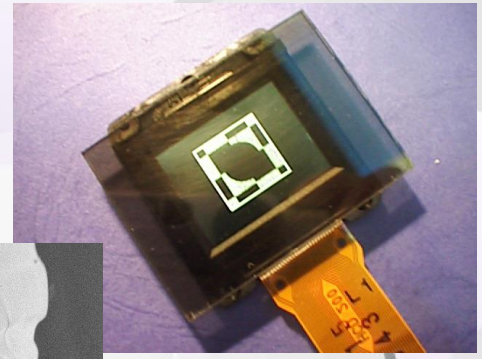
Technology Hub



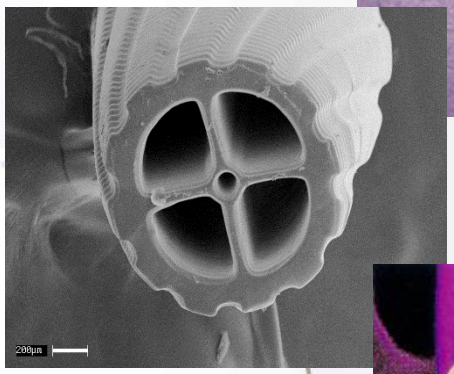
Technology Hub

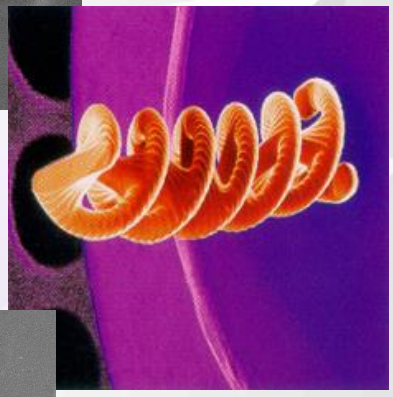
Micro-component Prototyping

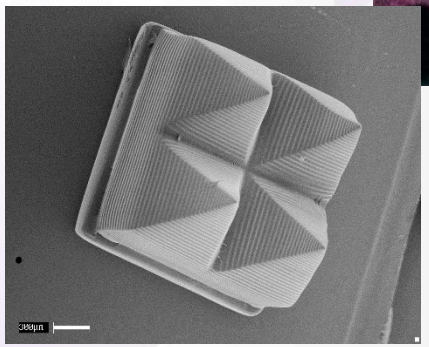
Microstereolithography System



SVGA SLM 800x600 pixels



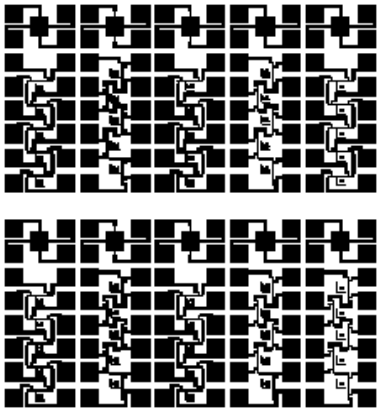




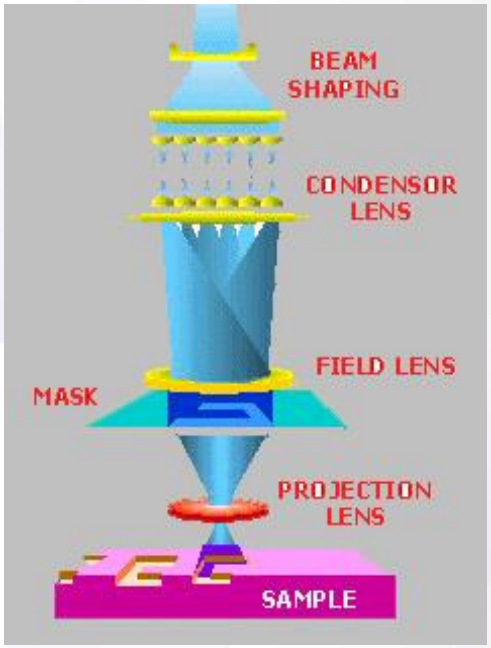
Technology Hub

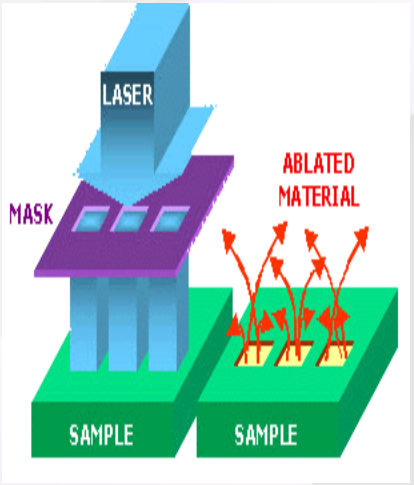
Micro-machining for Electronics & Sensors

Lambda Physik LPX 201i, 125W mean power, 2.5J/pulse,100 Hz prf, 10 to 50 ns pulse width



Chrome on Quartz Mask





Micro-fluidic systems

Technology Hub

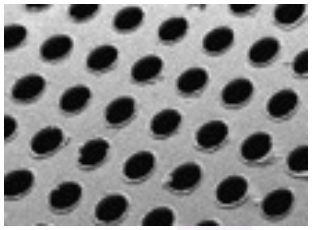
Class 10 Wet processing workstations
in a Class 100 Clean Room

Excimer Laser Dry Etching and Micro-machining in
A Class 1000 Clean room

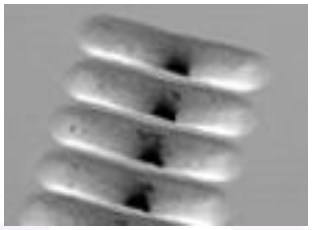
Technology Hub

Excimer Laser Micro-Machining

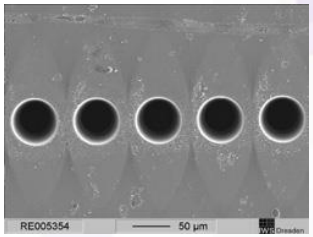
PCB Drilling



Printer Nozzles

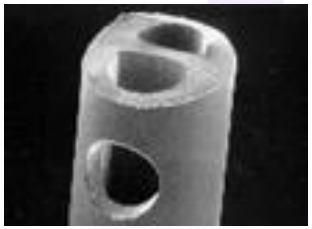


720 dpi nozzle holes

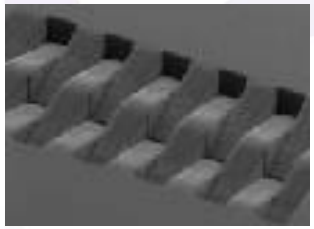


Micro-Fluidic Systems

Biomedical Devices

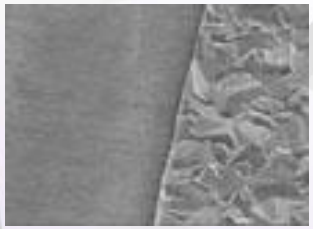


Microstructuring

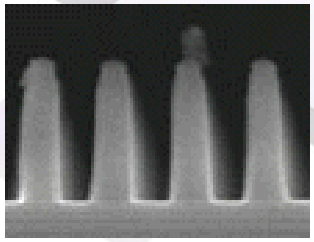


Fibre Gratings

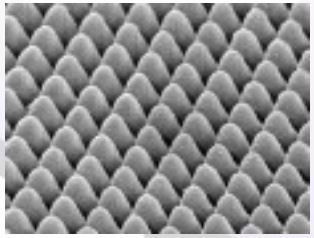
Diamond Smoothing



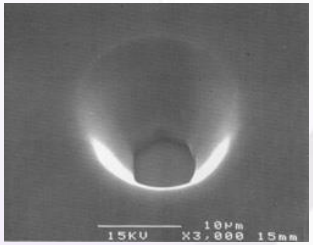
DUV Lithography



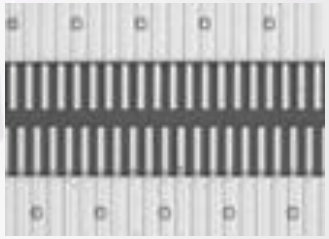
A-R Surface



Tapered micro-via

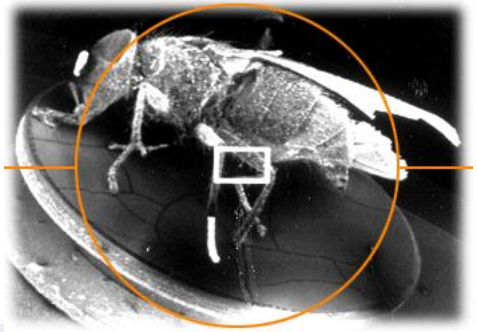


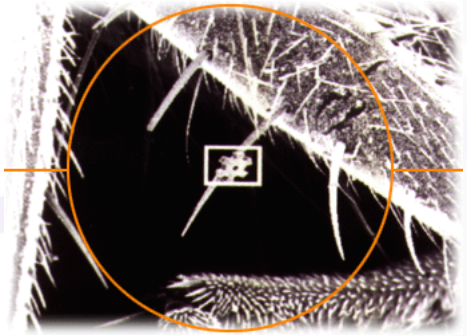
Sensors



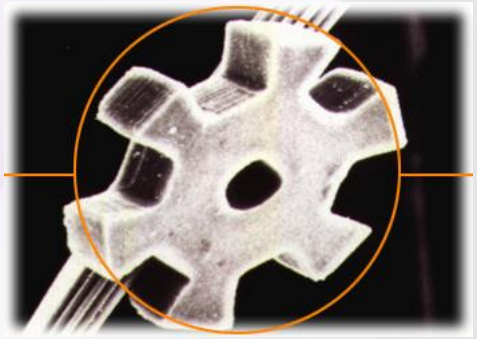
Technology Hub

Excimer Laser Micromachining



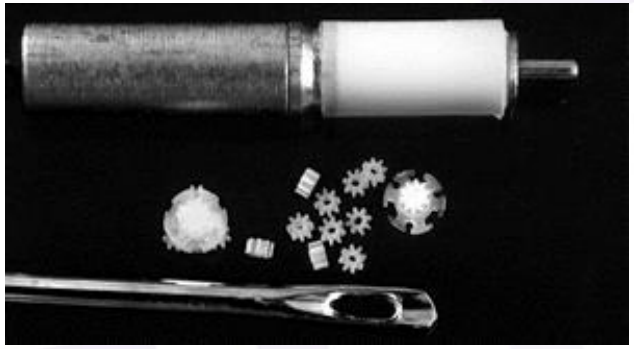


Gear 50 microns diameter



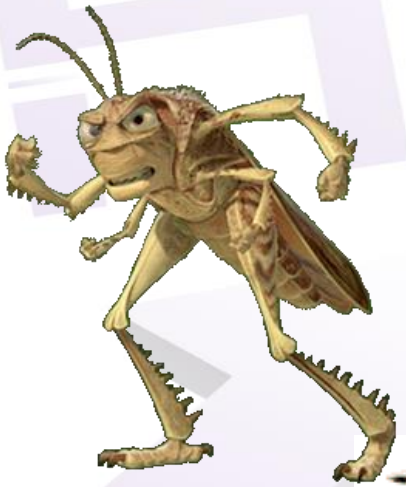
Technology Hub

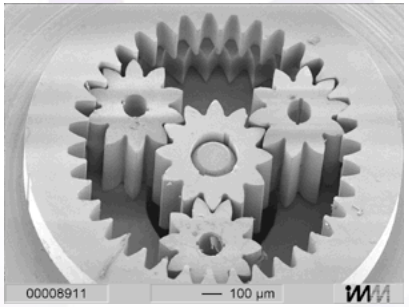
Micro-engineering Application



With a diameter of only 1.9 millimeters the electromagnetic motors can reach an incredible revolution speed of nearly 500,000 rpm.

They are also used for scanners, drive units in heart catheters and high-tech display systems.





The integrated planetary gear system converts low torque at high rotational speed into high torque at correspondingly lower rotational speed.

With a length of 24 mm and a weight of 0.4 grams the helicopter takes off at 40,000 rpm.

Institute of Microtechnology Mainz

Technology Hub

Poly-silicon Micro-Manufacturing

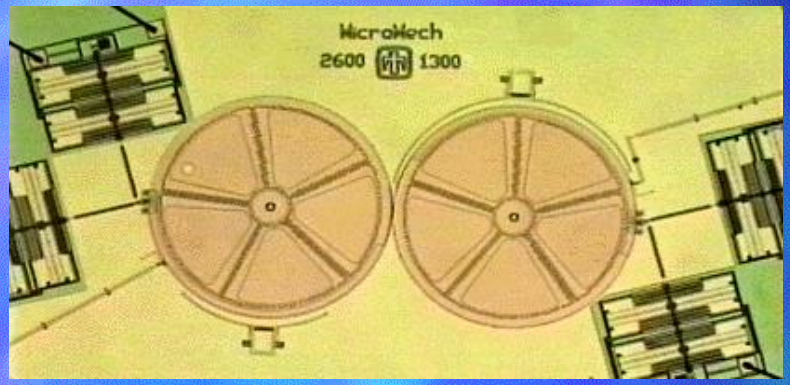
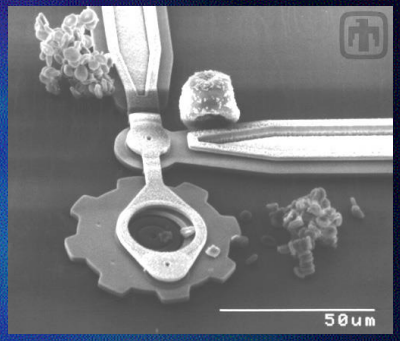
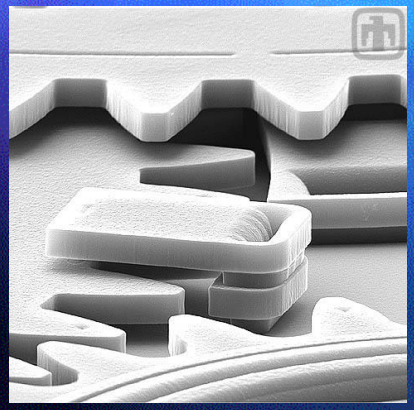


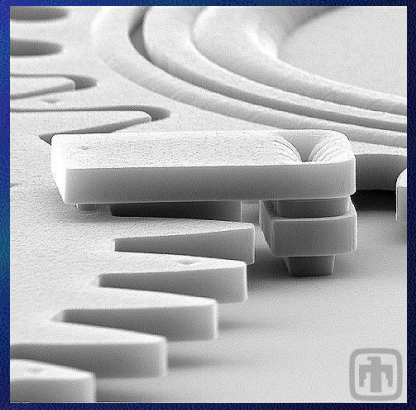
Figure 5. Flat 2000 micron diameter gears resulting from Sandia's 4-level, low stress, SUMMiT fabrication process.



Grain of pollen and red blood cells

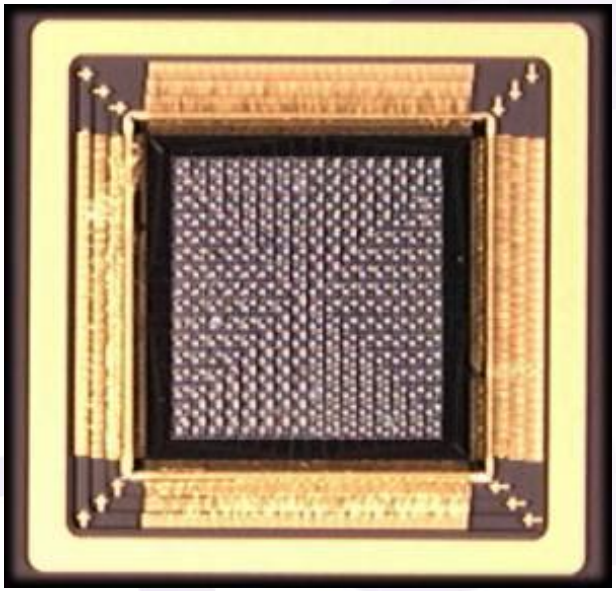


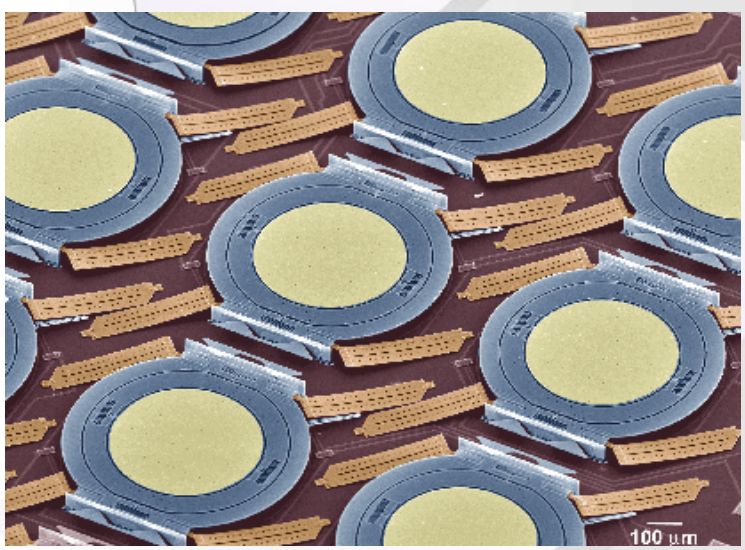
Alignment Clip
Meshing MEMS gears is a lot like meshing two sheets of paper; they are very thin. Alignment clips are used to help ensure these co-planar gears stay properly meshed.



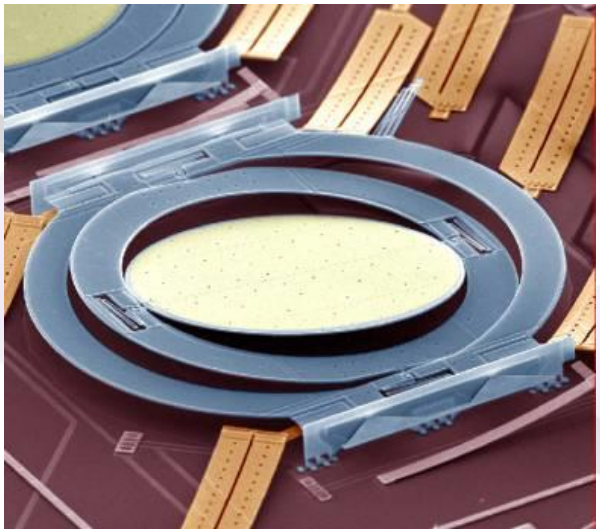
Technology Hub

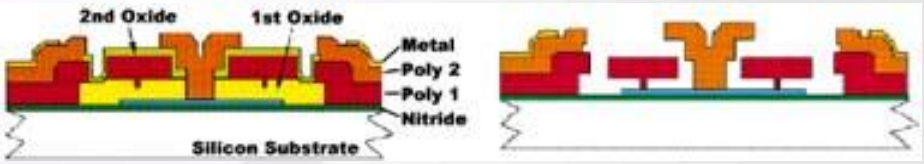
The Internet Needs Micro-engineering





Packaged Microstar Mirror Array with 256 mirrors

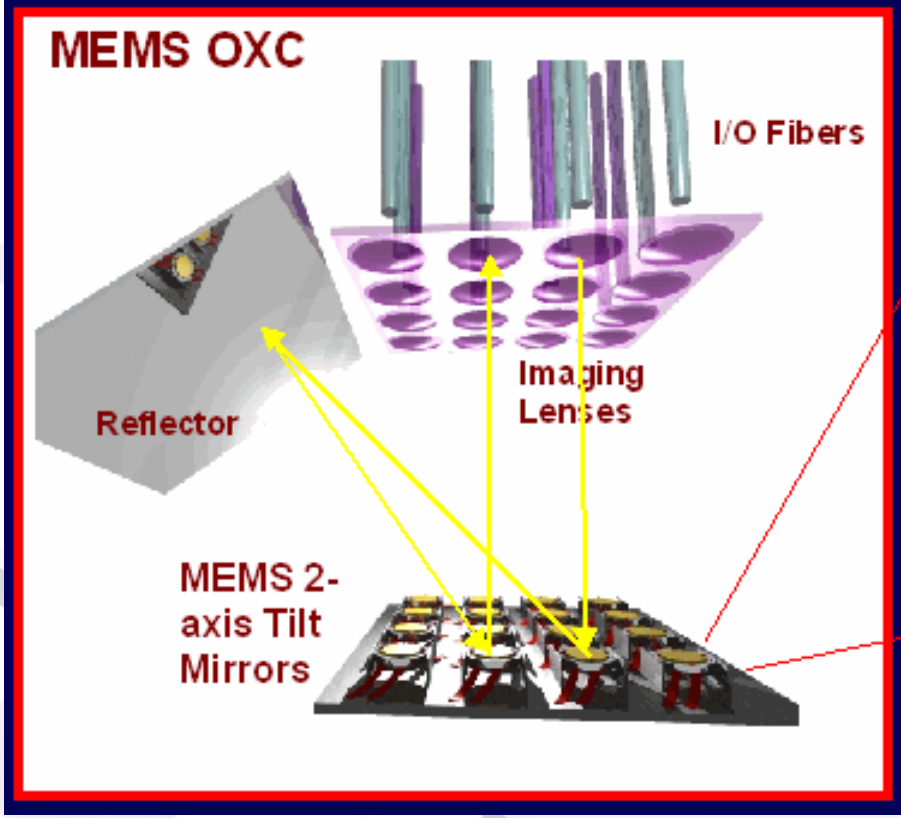




Technology Hub

Internet Switching

Lucent MEMS OXC



MEMS DEVICE:

- 2-axis, angular range of > ±6°
- continuous, controlled tilt
- directly scalable to 256 mirrors (1024 in the long term)
- simple technology for rapid development / prototyping
- manufacturable

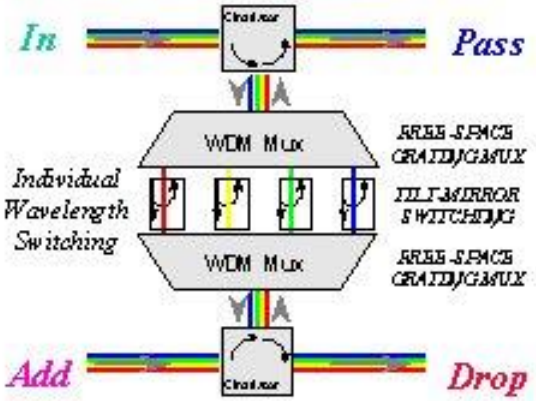
Technology Hub

Cross Connect Realisation

Technology Hub

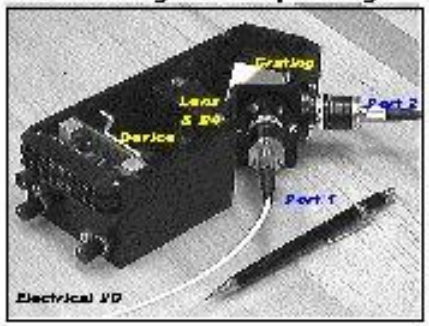
Wavelength-Selectable Add/Drop

Dynamic WDM network reconfiguration for SONET and Metropolitan WDM for efficient bandwidth allocation & fault recovery

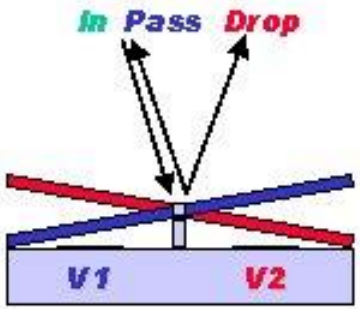


Free-space wavelength multiplexing onto MEMS tilt-mirror switches

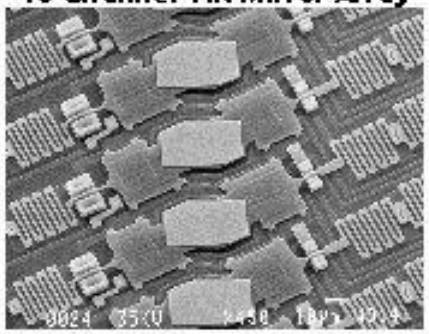
Wavelength Multiplexing



Switching

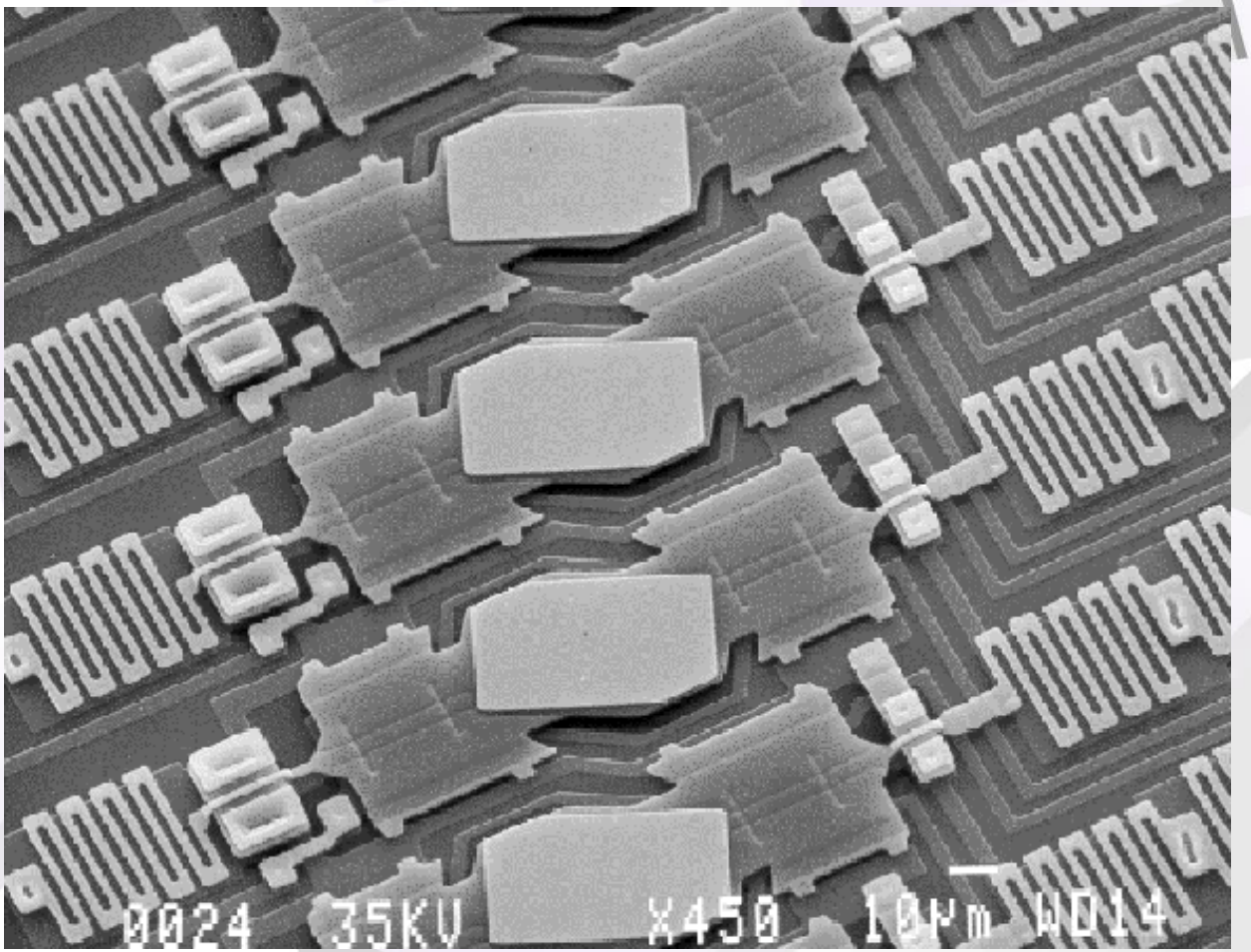


16 Channel Tilt-Mirror Array

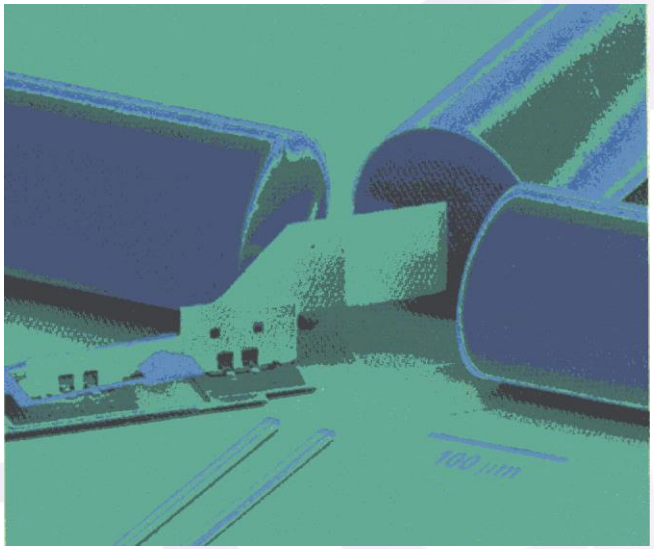


Technology Hub

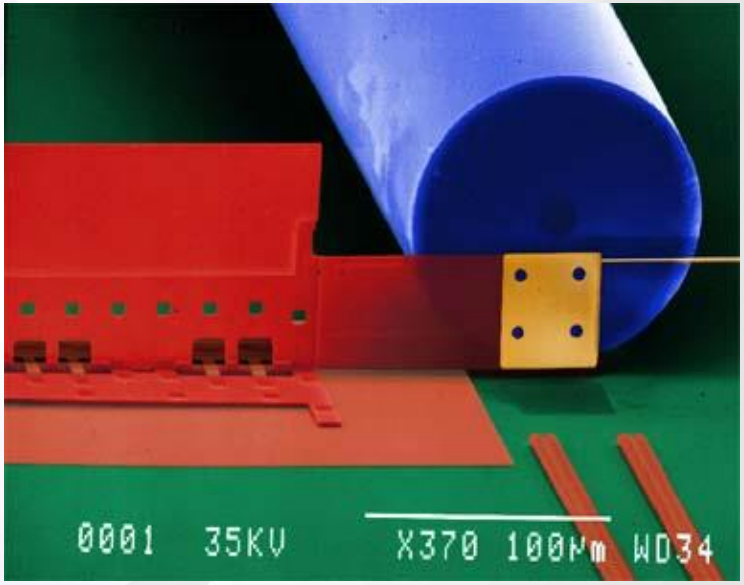
Add/Drop Multiplexer



Technology Hub



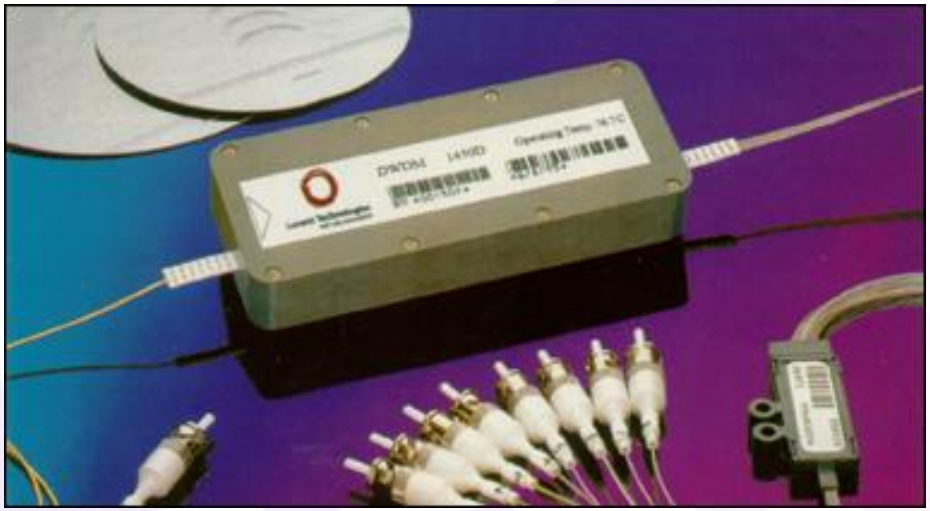
MEMS optical switch can route from the input fibre to one of the two output fibres



Self assembly techniques allow the hinged plate with the mirror to stand on its own during the release step

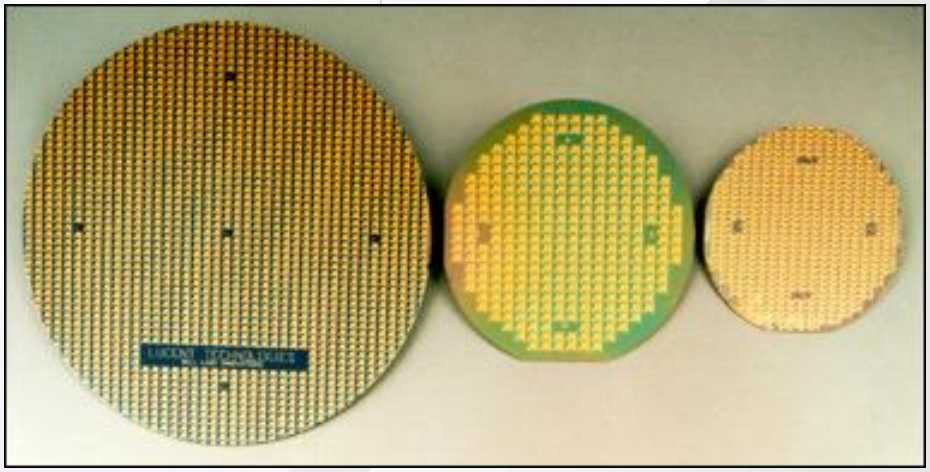
Technology Hub

Silicon Optical Bench (SiOB) Technology



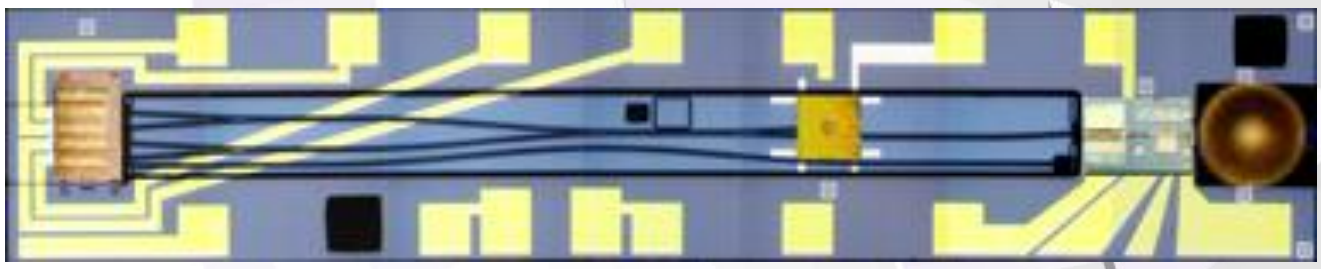
Silicon Optical Bench (SiOB) technology is a fabrication platform for integrated optical device components. This technology will find applications in optical networks, especially those where wavelength division multiplexing (WDM) is employed.

SiOB technology uses silicon wafers as a platform to fabricate passive and active integrated optical circuits. The formation of these circuits involves the deposition and patterning of oxides,patterning and deposition of of metals and solders, and deep anisotropic etching of the silicon for fibre and ball lens alignment

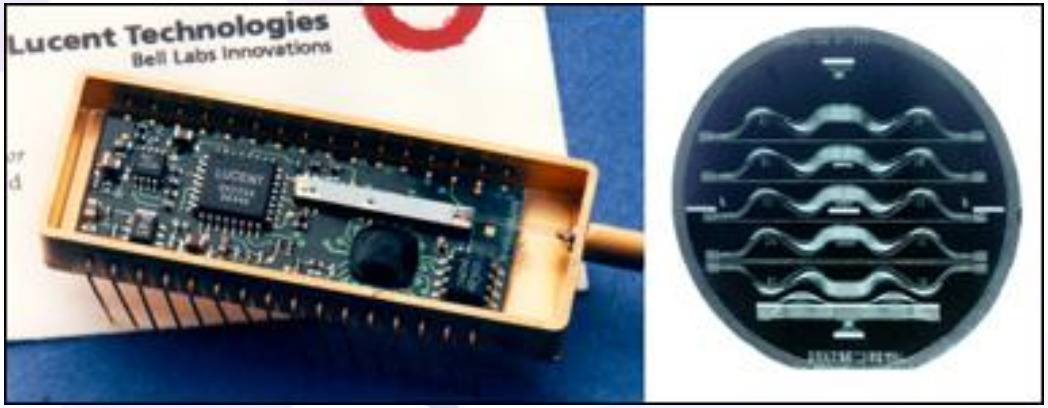


Technology Hub

Silicon Optical Bench (SiOB) Technology



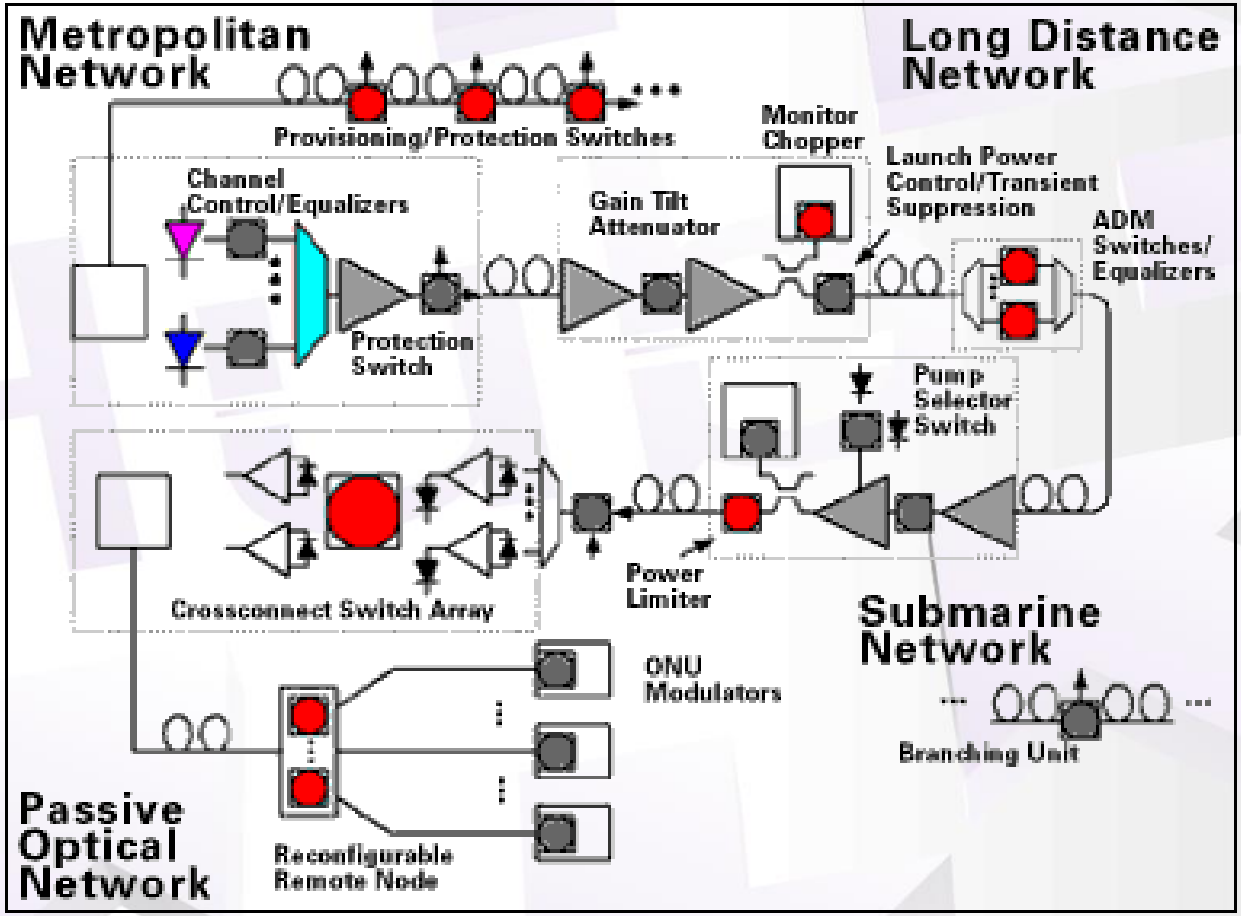
The example above demonstrates the use of the SiOB technology to form an integrated transceiver chip. In a fibre-to-the-home system, the transceiver would sit on the side of the home and provide the optical-to-electrical conversion , it operates at 150Mb/s



Packaged transceiver chip, can also be used to produce multiple wavelength sources, reconfigurable add/drop multiplexers, above right.

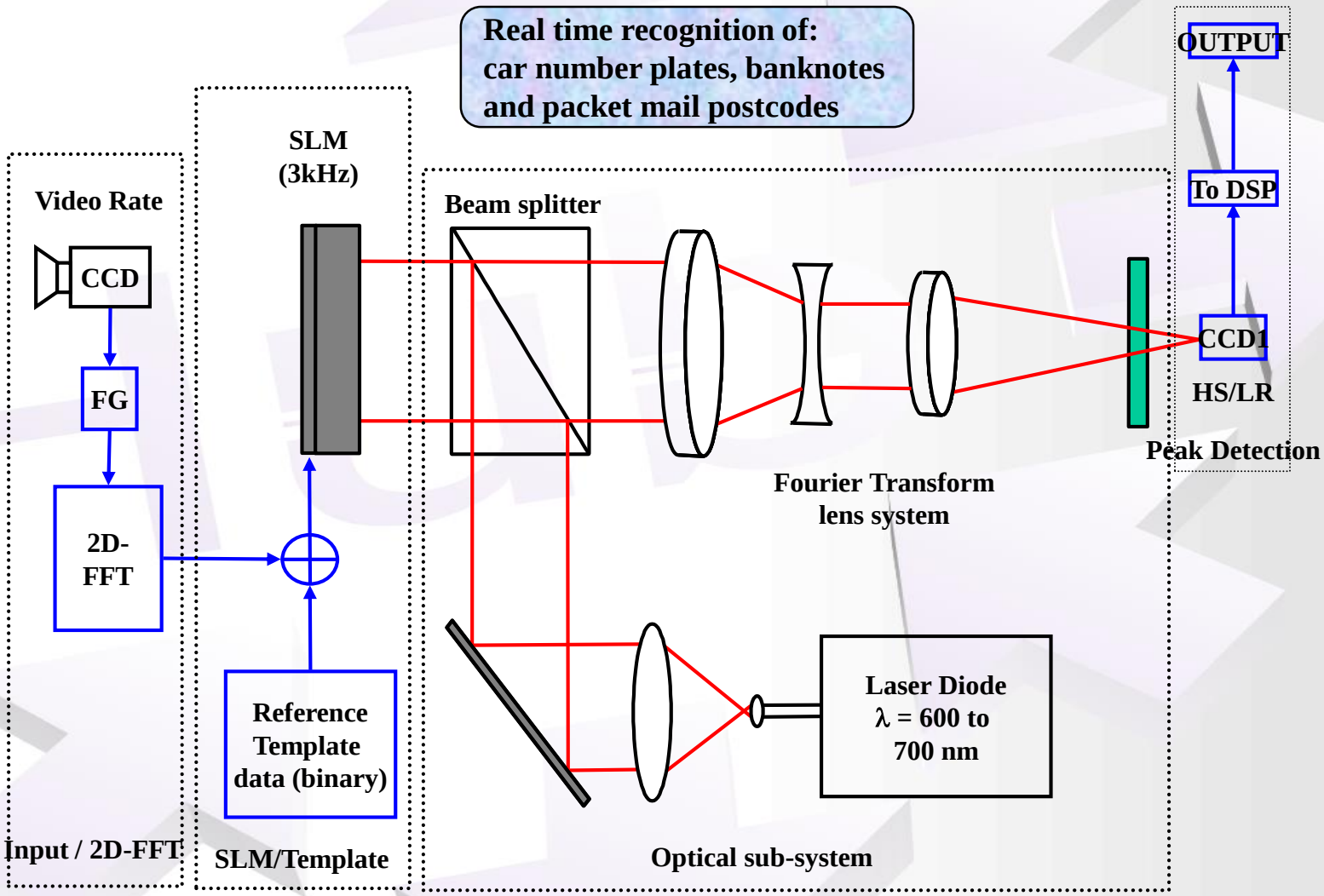
Technology Hub

Internet Infra-structure



Technology Hub

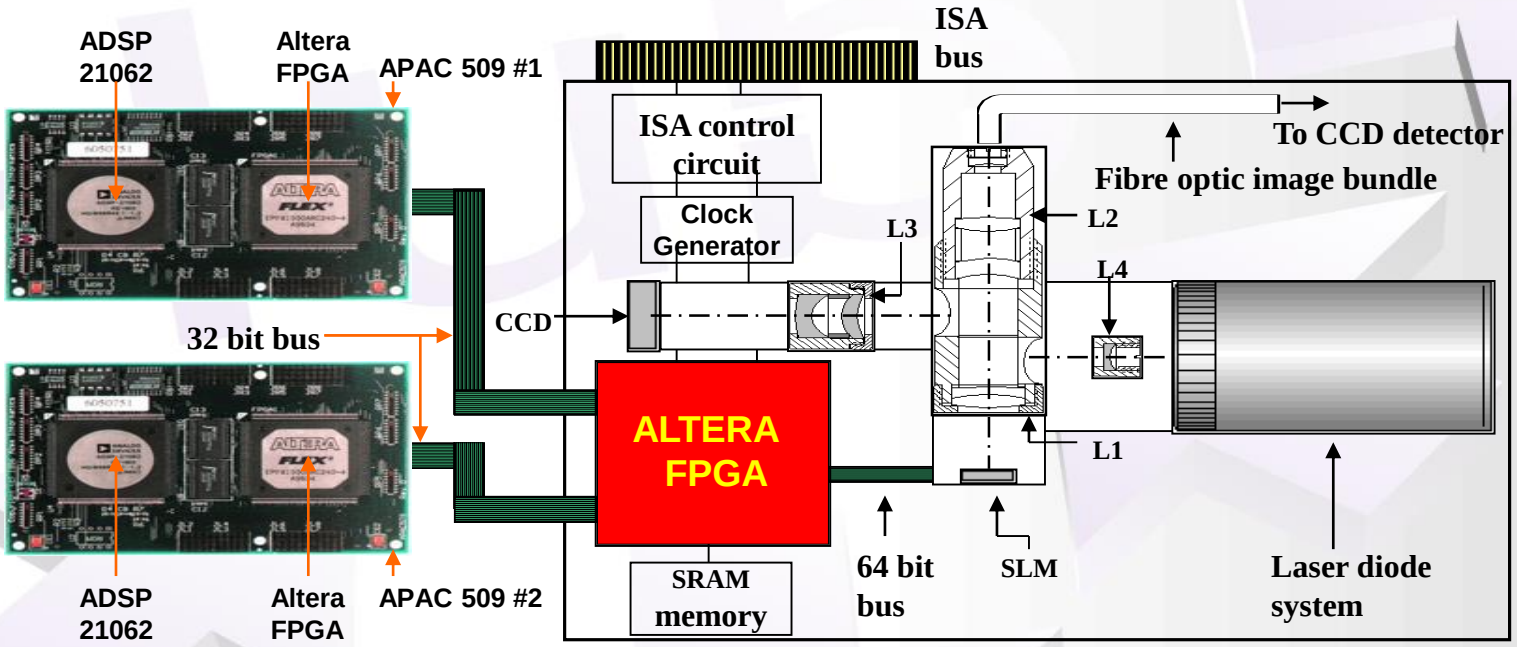
Image Processing & Photonics



Technology Hub

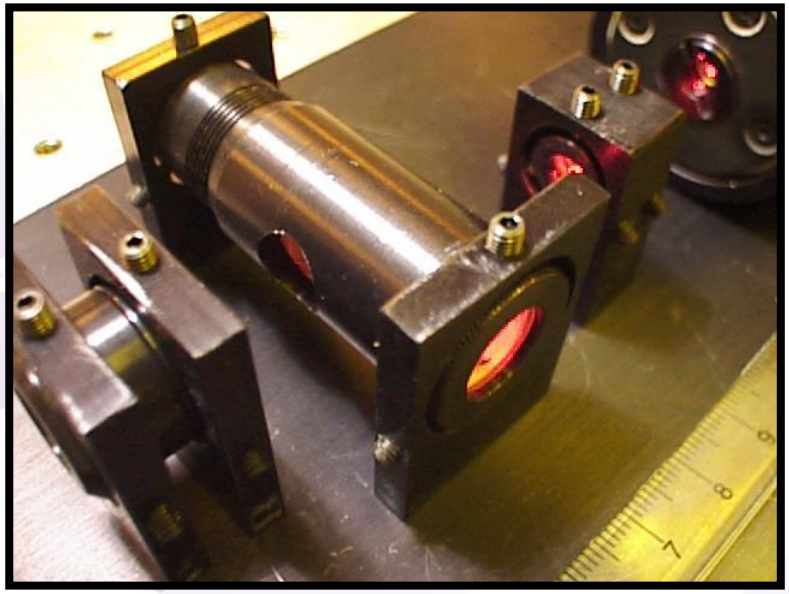
Image Processing & Photonics

Custom Hybrid Optical/Digital PC Card Layout

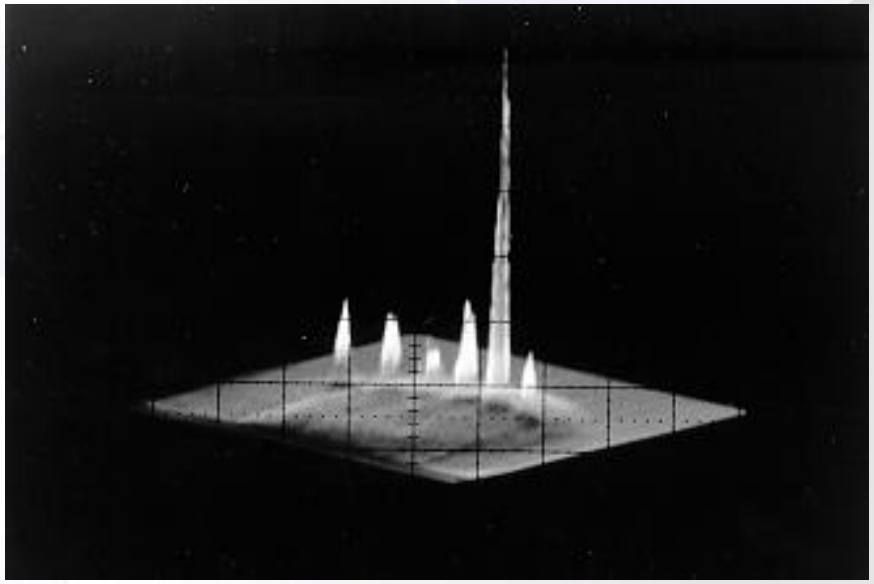


Technology Hub

Image Processing & Photonics



Miniaturised Optical Computer, plugs into PC bus



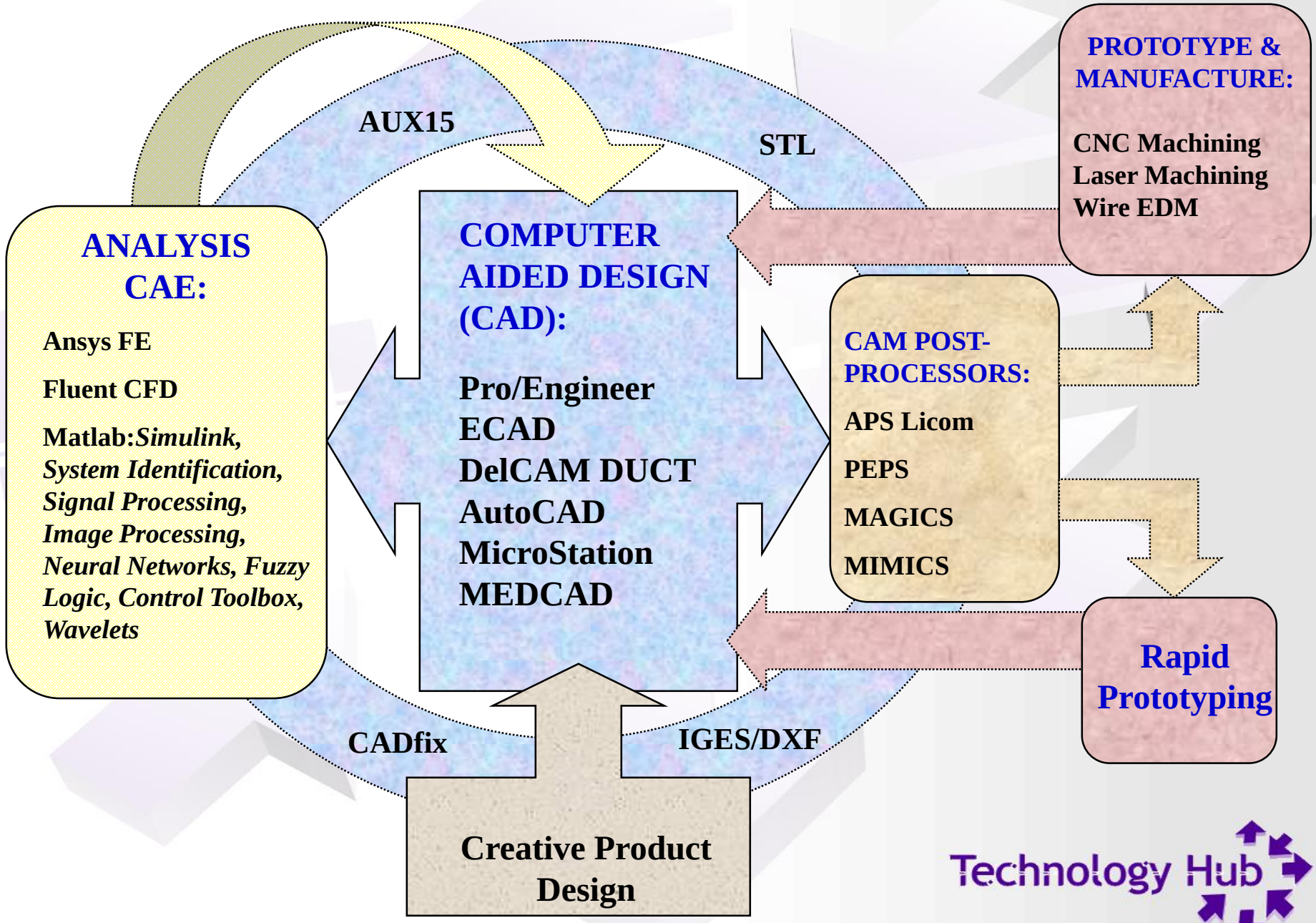
Output Correlation

Technology Hub

High Speed Car Number Plate Recognition

Technology Hub

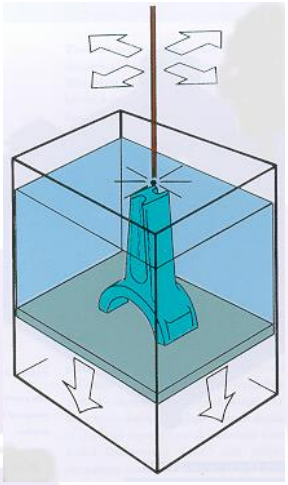
The EIT Software Environment for CAD, CAE & CAM



Technology Hub

Time Compression & Rapid Prototyping

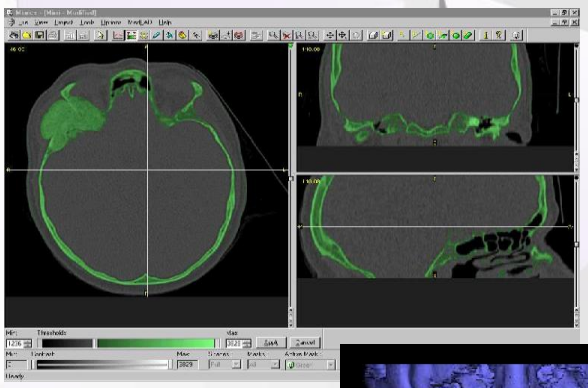
Stereolithography



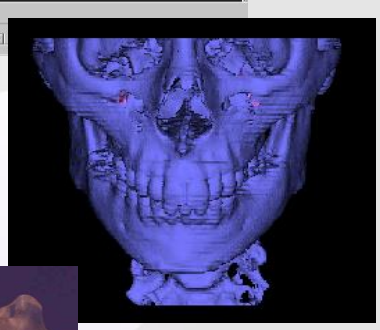
Courtesy of Ricardo

Sussex SLA 250

Magnetic Resonance Imaging

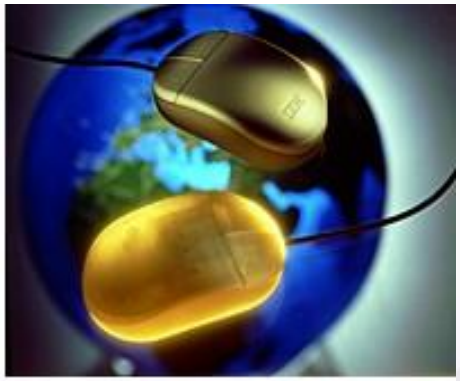


3D Model



SLA Model

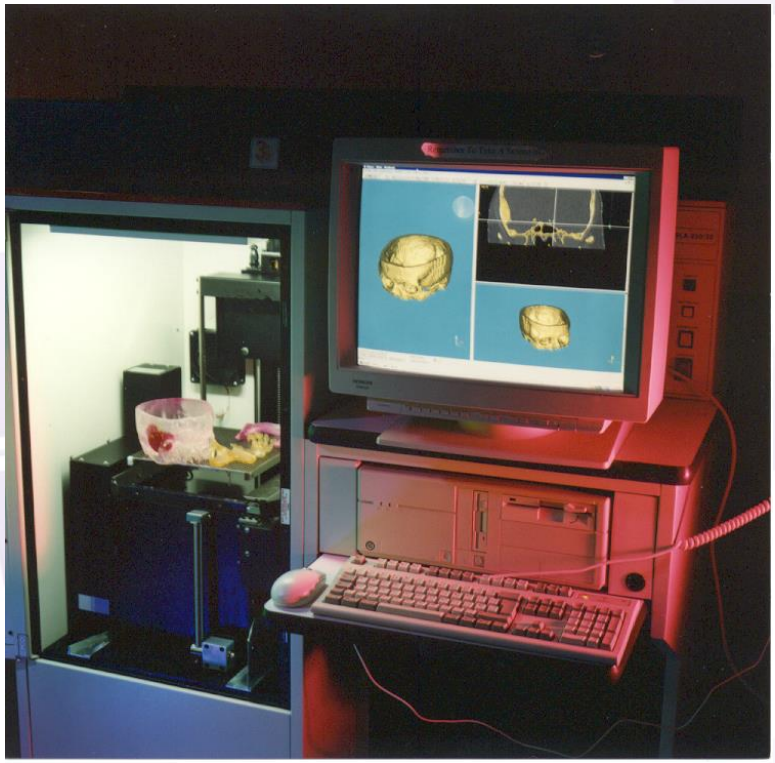
Daewoo manifold



Logitech - From quote to working prototype in 7 days - 3D Systems

Technology Hub

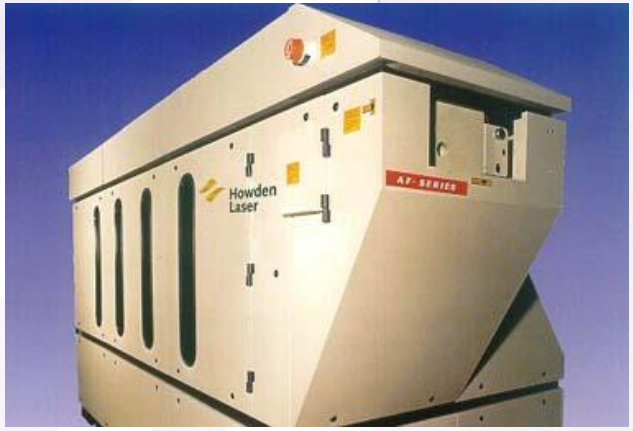
Sussex SLA250 Stereolithography

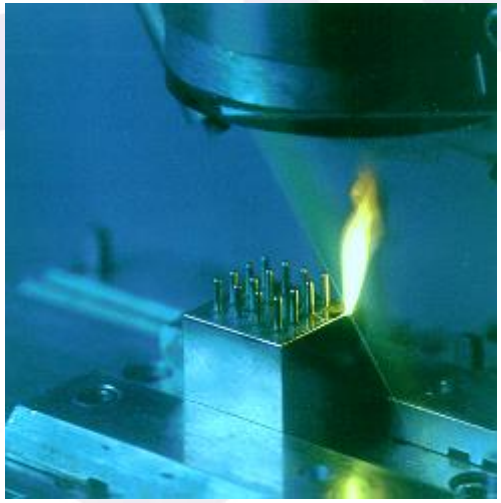


Data transfer over the Internet

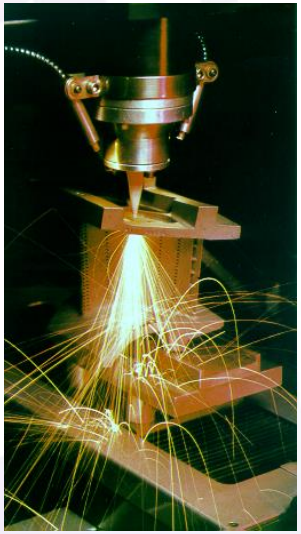
Technology Hub

Time Compression & Rapid Prototyping





Seam welding of relay cans. The The low heat input prevents damage to the adjacent glass to metal seals.

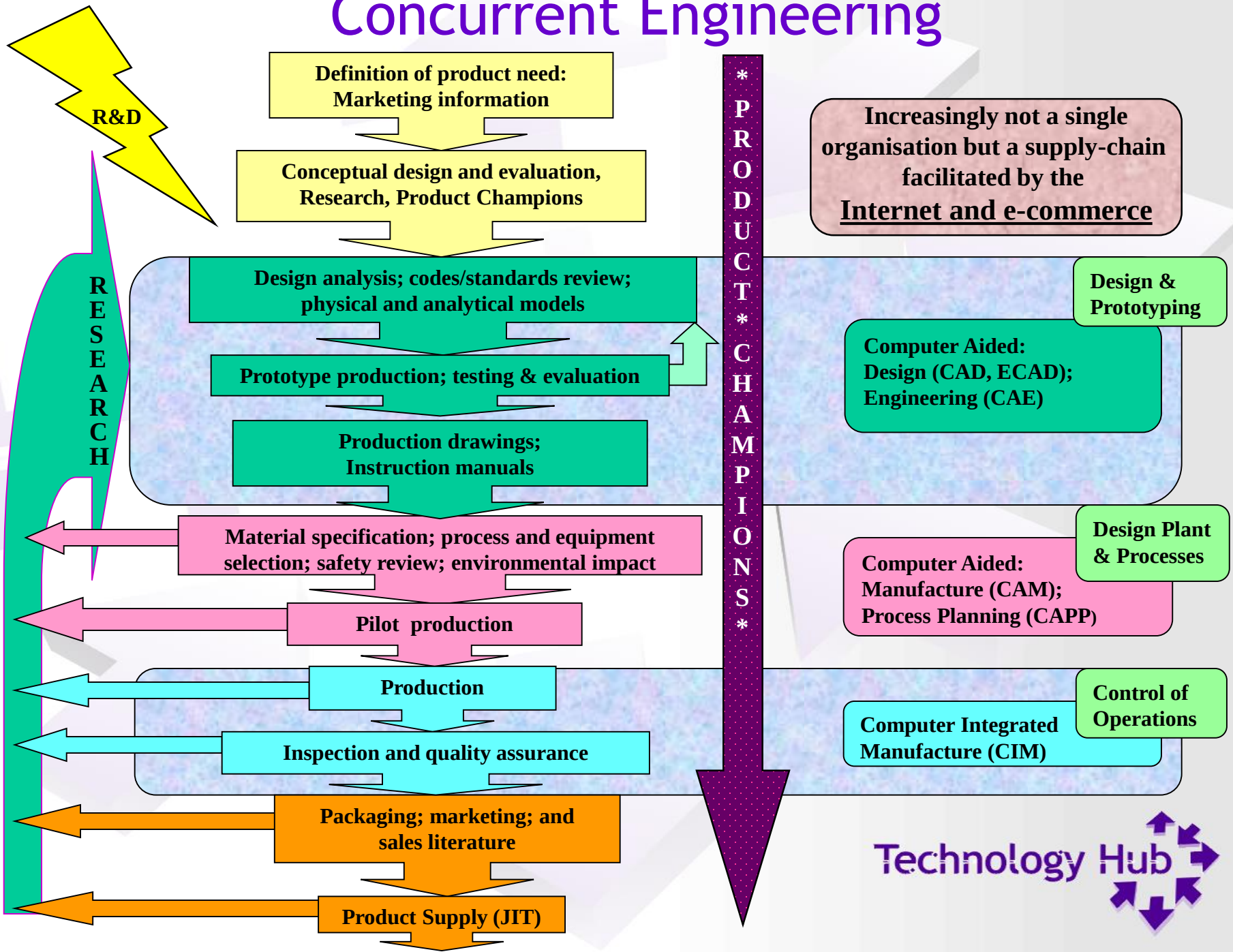


Jet-engine turbine blade - Nimonic alloy

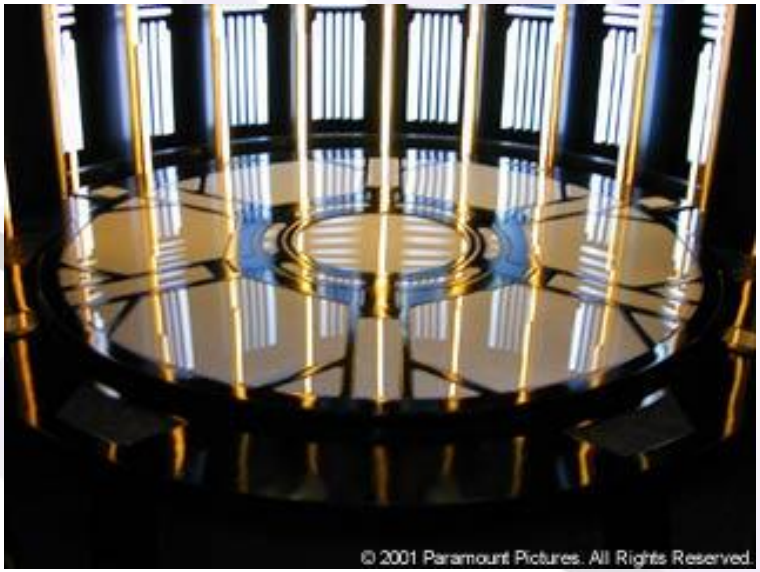
High speed drilling of blind and micro-vias in all types of PCB

Technology Hub

Concurrent Engineering



JIT Technology for Rapid Delivery of Stereolithography Models and Small Batches of Components – Ideal for the e-Commerce Supply Chain

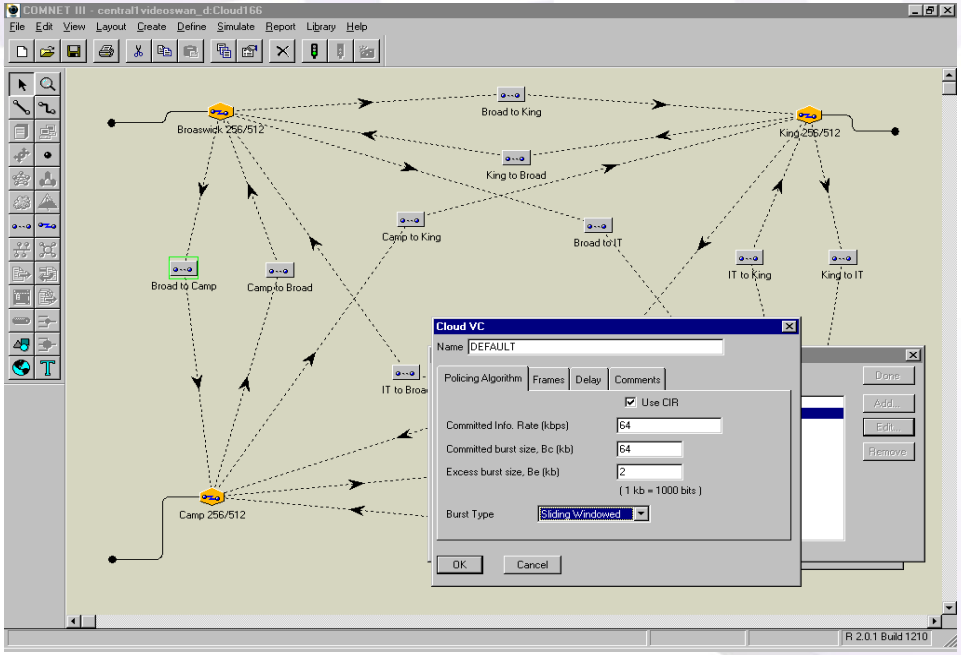


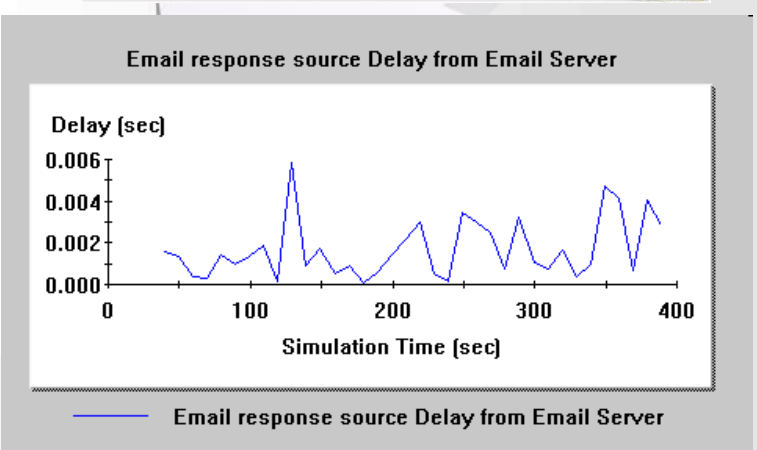
Technology Hub

Internet Data & E-Commerce

- Internet Data Management

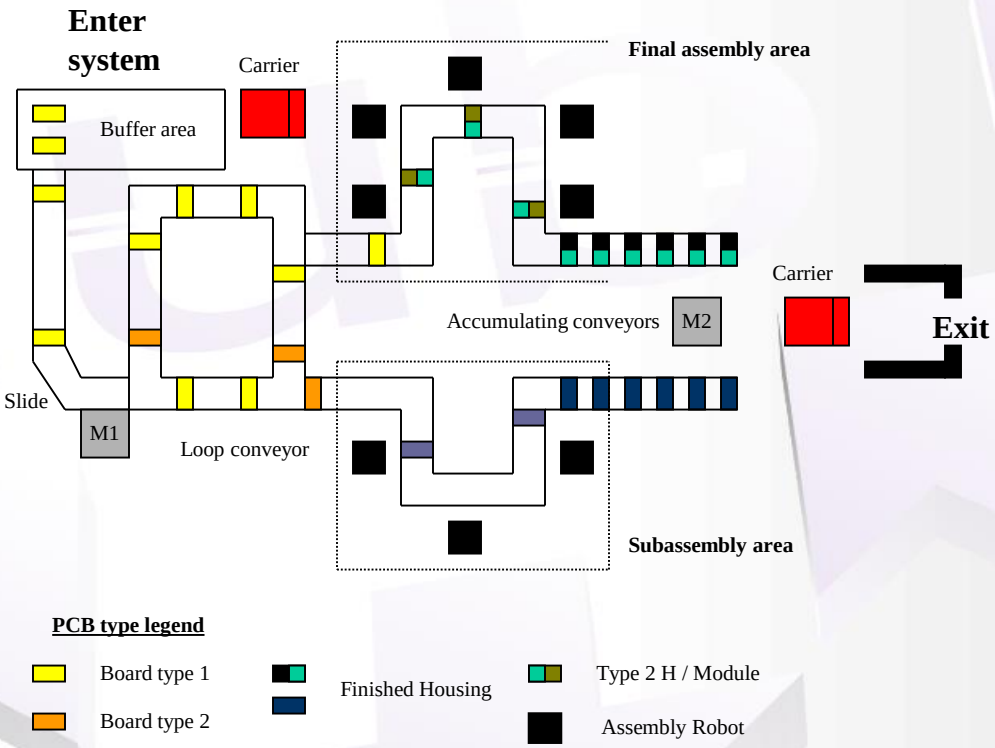
  Bandwidth and Capacity
  Connection Reliability
  Group Delays
  Priority & Security





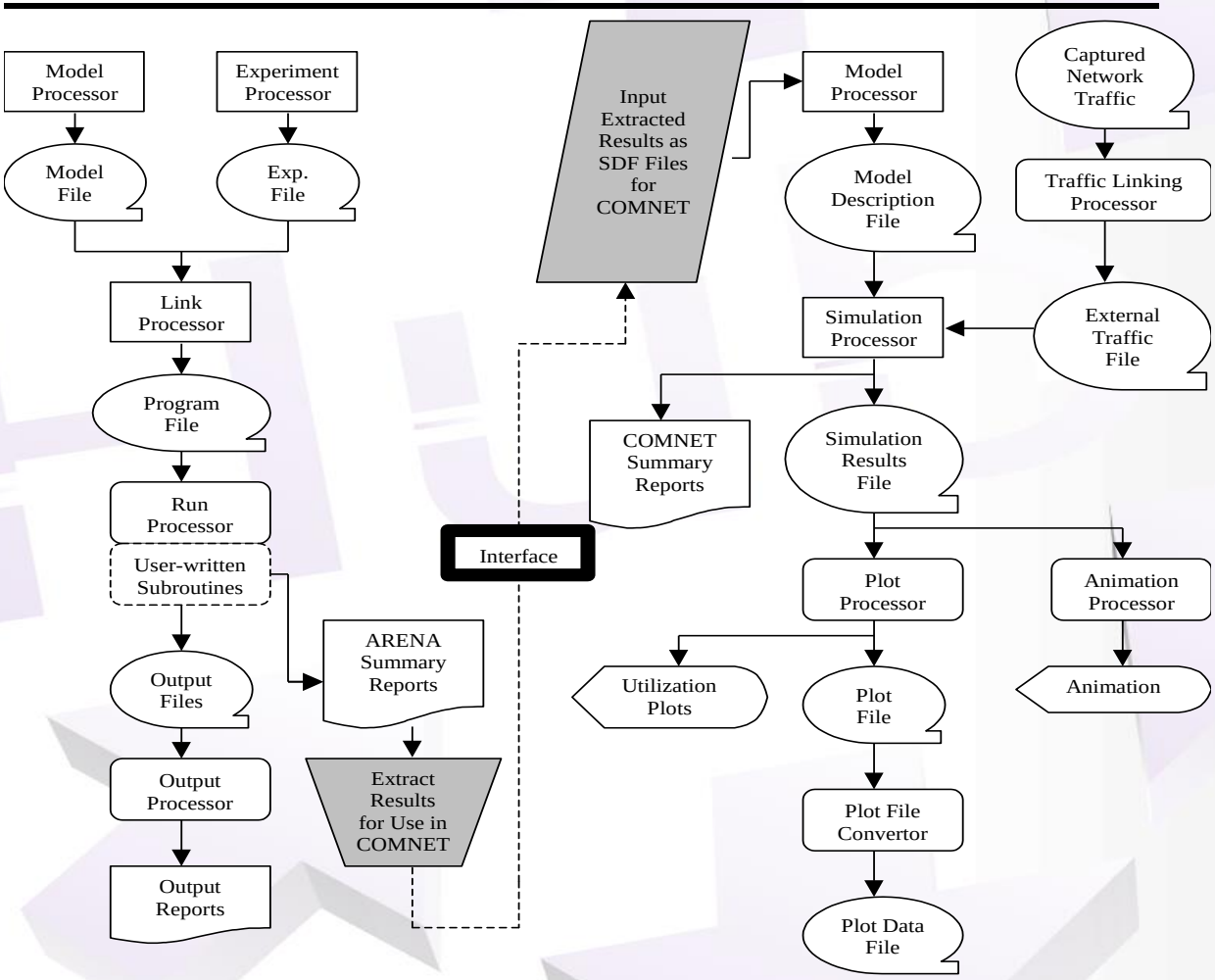
Technology Hub

Printed Circuit Board Assembly Line



Technology Hub

Principle of interconnection between ARENA 3.0 and COMNET III

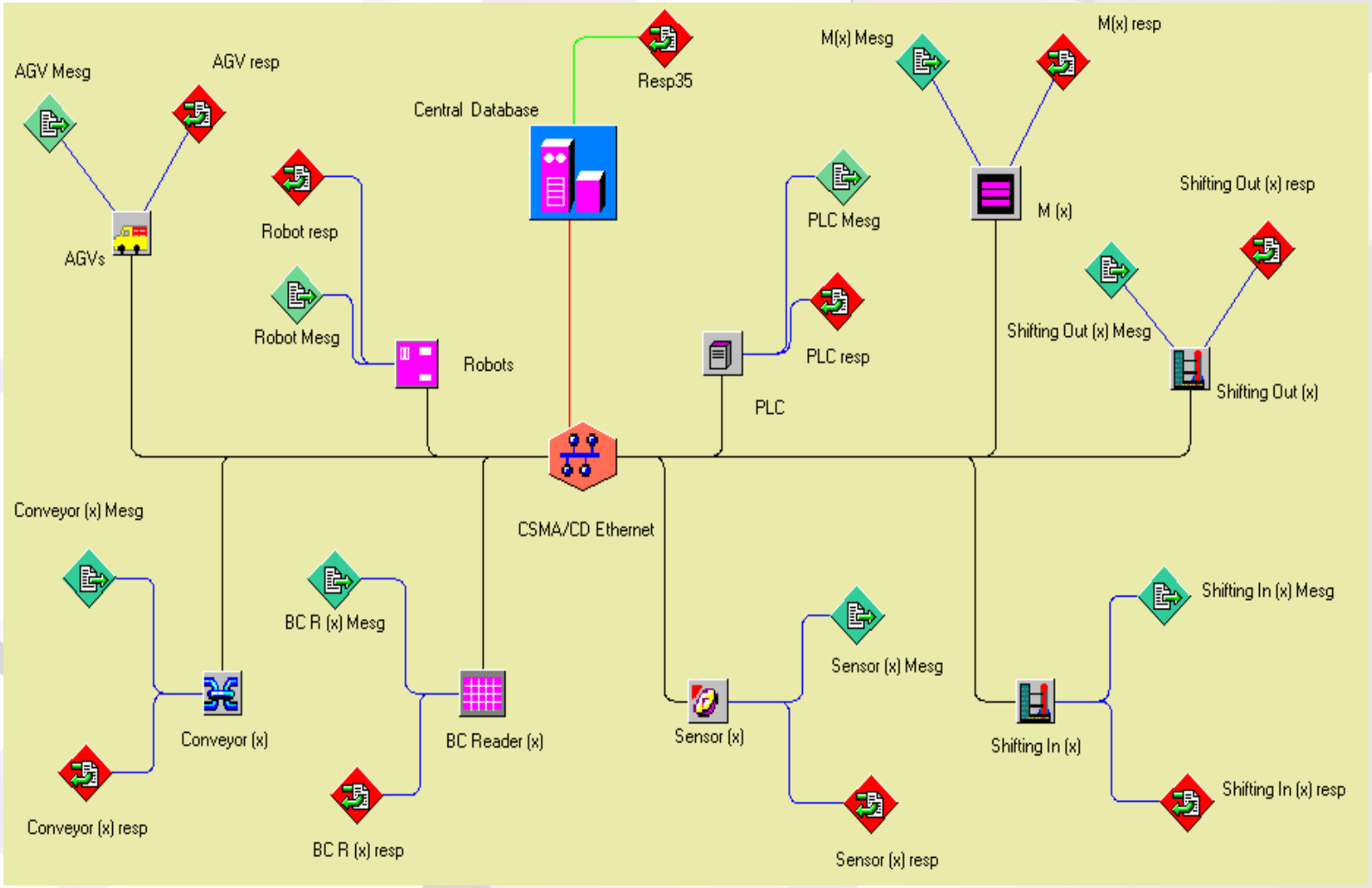


a) ARENA 3.0 Simulation Principle

b) COMNET III Simulation Principle

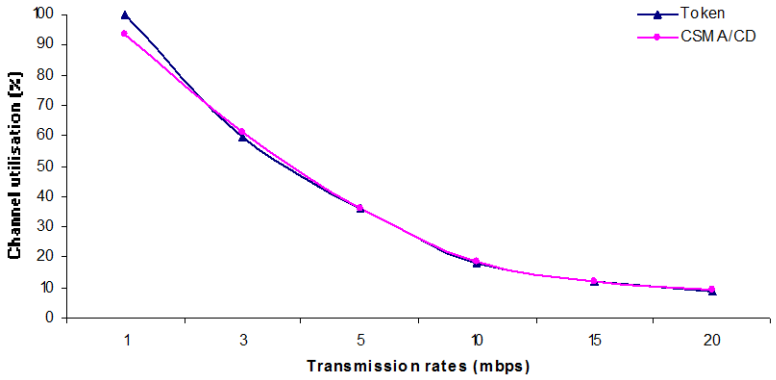
Technology Hub

PCBA communication system model built by COMNET III

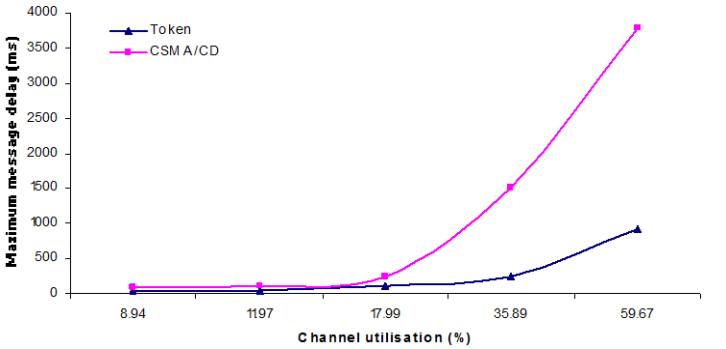


Technology Hub

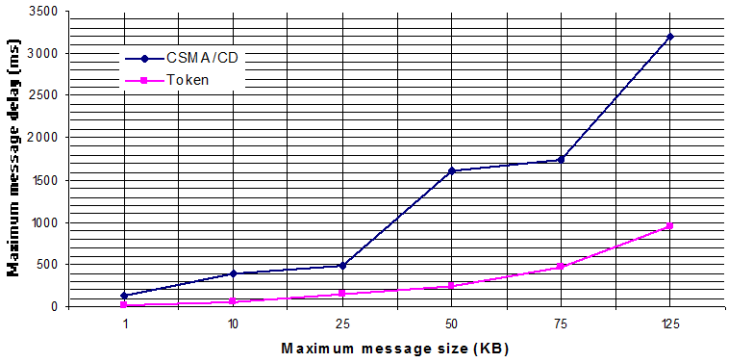
PCBA Line LAN Performance



Channel utilisation vs transmission rates for token passing and Carrier-Sense Multiple Access with Collision Detection (CSMA/CD) LANs

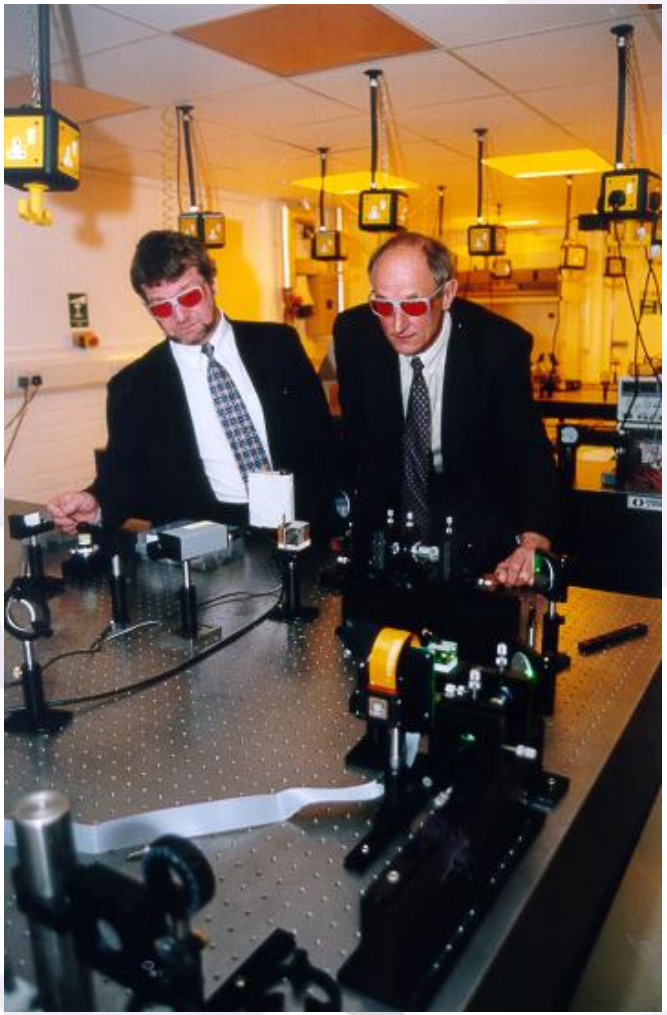


Maximum message delay vs channel utilisation for token passing and CSMA/CD LANs



Maximum message delay vs maximum message sizes for token passing and CSMA/CD LANs

Technology Hub

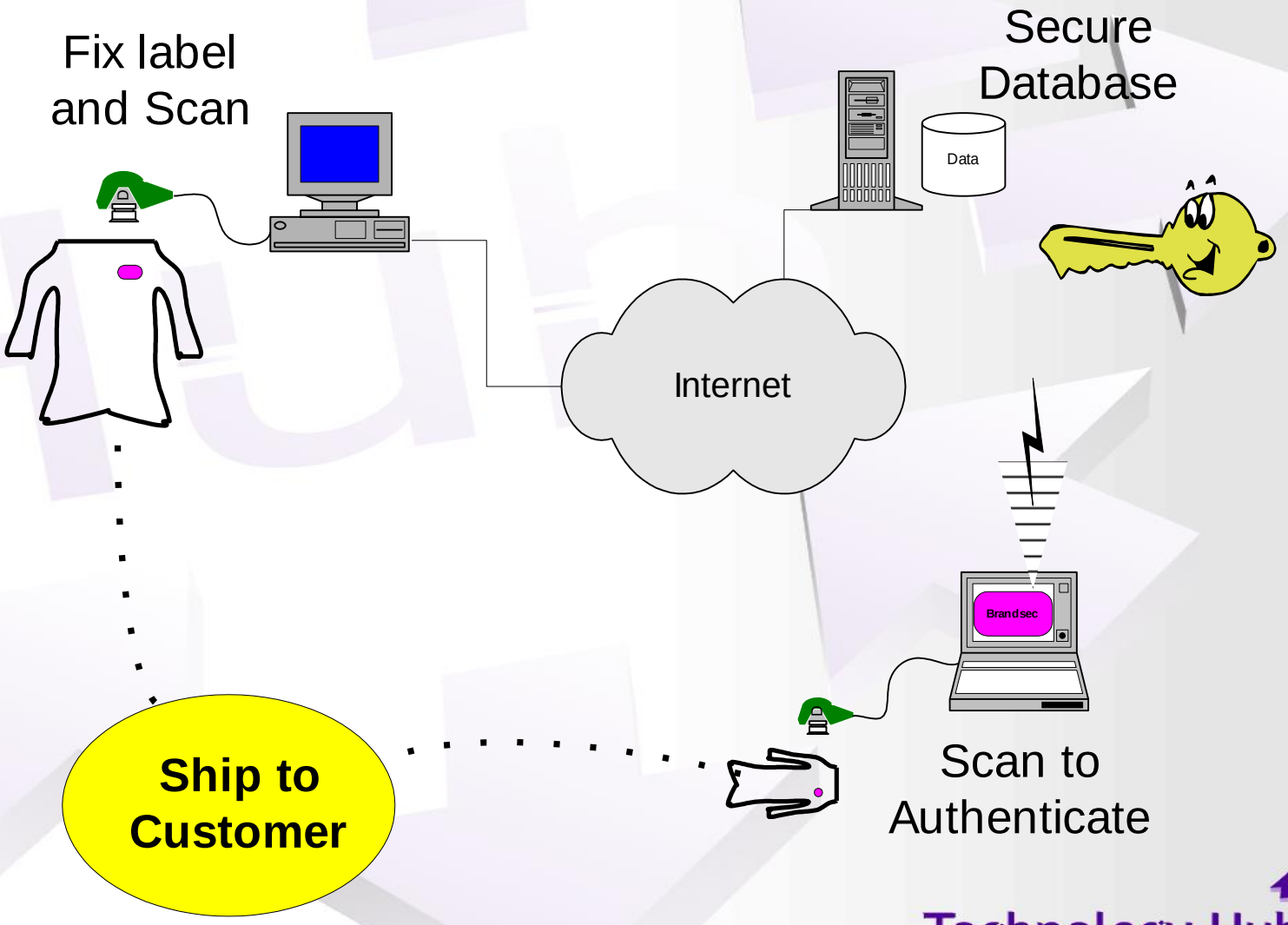


Optical Computing Facility

BRANDSEC – Product Security Project Team

Technology Hub

Product Security Over the Internet



Technology Hub

Company Capabilities Database

in conjunction with Sussex Enterprise

Over 1500 local companies with products and services available via the internet.

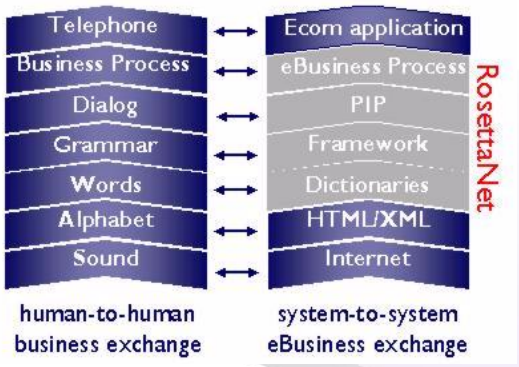
Company updated "hot" pages with:

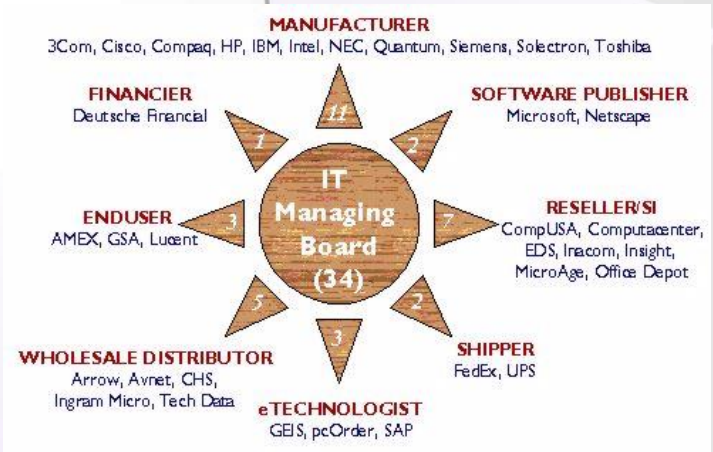
Capability: skills, capacity,prices and delivery

Equipment: Computing, simulation, visualisation modelling, realisation, machining etc.

Staff: specialist knowledge.

Towards Internet EDI





Technology Hub

Company Capabilities Database

- Companies normally use the internet to advertise their products into markets
- This internet database has Market Sector focus
  - Electronics, Biomedical, Automotive etc
- Market Sector Tree Structure
  - Sectors pre defined and SIC compatible
    - Sub sectors of interest
      - Company Facilities eg production, research
      - skills and capacity. eg Prototypes, high volume.
- Typical queries:
  - Companies serving automotive markets?
    - Spare injection moulding capacity?
    - 3D CAD design capabilities ?
- Company Driven and updated

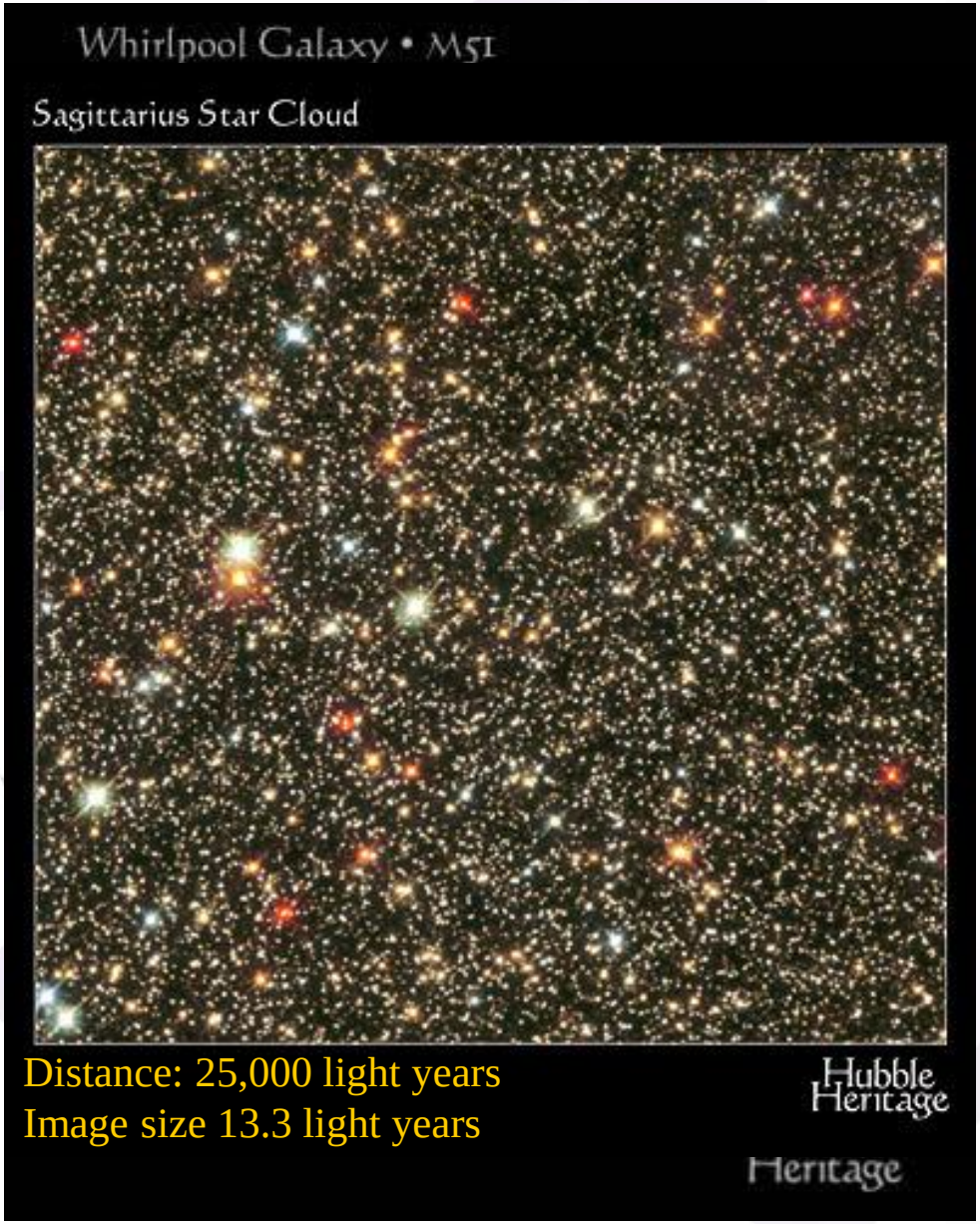
Technology Hub

Company Capabilities Database

- Next stages
  - Load Database with existing sector data
  - Invite companies to update their details
  - Provide Hotmail to company server and website
  - Integrate CCD into other sites
  - Use as test bed for similar applications

Technology Hub

We Must Continue to do Long-Term Research Which Appears to Have No Immediate Commercial Benefit



NASA's Hubble Space Telescope has given us a keyhole view towards the heart of our Milky Way Galaxy, where a dazzling array of stars reside. Most of the view of our galaxy is obscured by dust. Hubble peered into the Sagittarius Star Cloud, a narrow, dust-free region, providing this spectacular glimpse of a treasure chest full of stars.

Technology Hub

References

1) C Chatwin, M Farsari, S Huang, M Heywood, P Birch, R Young, "UV microstereolithography system that uses spatial light modulator technology," Applied optics 37 (32), 7514-7522, 1998
2) M Farsari, S Huang, RCD Young, MI Heywood, PJB Morrell, CR Chatwin, "Holographic characterization of epoxy resins at 351.1 nm," Optical Engineering 37 (10), 2754-2759, 1998
3) M Farsari, S Huang, RCD Young, MI Heywood, PJB Morrell, CR Chatwin, "Four-wave mixing studies of UV curable resins for microstereolithography," Journal of Photochemistry and Photobiology A: Chemistry 115 (1), 81-87, 1998
4) M Farsari, S Huang, P Birch, F Claret-Tournier, R Young, D Budgett, "Microfabrication by use of a spatial light modulator in the ultraviolet: experimental results," optics letters 24 (8), 549-550, 1999
5) CR Chatwin, M Farsari, S Huang, MI Heywood, RCD Young, PM Birch, "Characterisation of epoxy resins for microstereolithographic rapid prototyping," The International Journal of Advanced Manufacturing Technology 15 (4), 281-286, 1999
6) GD Ward, IA Watson, DES Stewart-Tull, AC Wardlaw, CR Chatwin, "Inactivation of bacteria and yeasts on agar surfaces with high power Nd: YAG laser light," Letters in applied microbiology 23 (3), 136-140, 1996
7) M Farsari, S Huang, RCD Young, MI Heywood, CD Bradfield, CR Chatwin, "Holographic cure monitoring of the DuPont Somos TM 7100 stereolithography resin," Optics and lasers in engineering 31 (3), 239-246, 1999
8) M Farsari, F Claret-Tournier, S Huang, CR Chatwin, DM Budgett, "A novel high-accuracy microstereolithography method employing an adaptive electro-optic mask," Journal of Materials processing technology 107 (1), 167-172, 2000
9) P Birch, R Young, C Chatwin, M Farsari, D Budgett, J Richardson, "Fully complex optical modulation with an analogue ferroelectric liquid crystal spatial light modulator," Optics communications 175 (4), 347-352, 2000
10) PM Birch, R Young, D Budgett, C Chatwin, "Two-pixel computer-generated hologram with a zero-twist nematic liquid-crystal spatial light modulator," Optics letters 25 (14), 1013-1015, 2000
11) P Birch, R Young, M Farsari, C Chatwin, D Budgett, "A comparison of the iterative Fourier transform method and evolutionary algorithms for the design of diffractive optical elements," Optics and Lasers in engineering 33 (6), 439-448, 2000
12) P Birch, R Young, D Budgett, C Chatwin, "Dynamic complex wave-front modulation with an analog spatial light modulator," Optics letters 26 (12), 920-922, 2001

Technology Hub

References

13) RKK Wang, L Shang, CR Chatwin, “Modified fringe-adjusted joint transform correlation to accommodate noise in the input scene,” Applied optics 35 (2), 286-296, 1996
14) P Birch, R Young, C Chatwin, M Farsari, D Budgett, J Richardson, “Fully complex optical modulation with an analogue ferroelectric liquid crystal spatial light modulator,” Optics communications 175 (4), 347-352, 2000
15) RCD Young, CR Chatwin, BF Scott, “High-speed hybrid optical/digital correlator system,” optical engineering 32 (10), 2608- 2615, 1993
16) PM Birch, R Young, D Budgett, C Chatwin, “Two-pixel computer-generated hologram with a zero-twist nematic liquid-crystalspatial light modulator,” Optics letters 25 (14), 1013-1015, 2000
17) GD Ward, IA Watson, DES Stewart-Tull, AC Wardlaw, CR Chatwin, “Inactivation of bacteria and yeasts on agar surfaces with high power Nd: YAG laser light,” Letters in applied microbiology 23 (3), 136-140, 1996
18) LS Jamal-Aldin, RCD Young, CR Chatwin, “Application of nonlinearity to wavelet-transformed images to improve correlation filter performance,” Applied optics 36 (35), 9212-9224, 1997
19) LS Jamal-Aldin, RCD Young, CR Chatwin, “Synthetic discriminant function filter employing nonlinear space-domain preprocessing on bandpass-filtered images,” Applied optics 37 (11), 2051-2062, 1998
20) RKK Wang, CR Chatwin, L Shang, “Synthetic discriminant function fringe-adjusted joint transform correlator,” Optical Engineering 34 (10), 2935-2944, 1995
21) S Tan, RCD Young, DM Budgett, JD Richardson, CR Chatwin, “A pattern recognition Weiner filter for realistic clutter backgrounds,” Optics communications 172 (1), 193-202, 1999
22) R.C.D. Young, C.R. Chatwin, “Design and simulation of a synthetic discriminant function filter for implementation in an updateable photorefractive correlator” , SPIE Aerospace Sensing, pp 239-263, 1992.
23) RK Wang, CR Chatwin, MY Huang, “Modified filter synthetic discriminant functions for improved optical correlator performance,” Applied optics 33 (32), 7646-7654, 1994
24) S Tan, RCD Young, DM Budgett, JD Richardson, CR Chatwin, “Performance comparison of a linear parametric noise estimation Wiener filter and non-linear joint transform correlator for realistic clutter backgrounds,” Optics communications 182 (1), 83-90, 2000

Technology Hub

References

25) CG Ho, RCD Young, CD Bradfield, CR Chatwin, “A fast Hough transform for parameterisation of straight lines using fourier methods,” Real-Time Imaging 6 (2), 113-127, 2000
26) JH Sharp, DM Budgett, CR Chatwin, BF Scott, “High-speed, acousto-optically addressed optical memory,” Applied optics 35 (14), 2399-2402, 1996
27) RK Wang, CR Chatwin, RCD Young, Assessment of a Wiener filter synthetic discriminant function for optical correlation, Optics and lasers in engineering 22 (1), 33-51, 1995
28) RCD Young, CR Chatwin, “Experimental assessment of a photorefractive bandpass joint transform correlator,” Optical Engineering 36 (10), 2754-2774, 1997
29) DM Budgett, PE Tang, JH Sharp, CR Chatwin, RCD Young, RK Wang, “Parallel pixel processing using programmable gate arrays,” Electronics Letters 32 (17), 1557-1559, 1996
30) JH Sharp, DM Budgett, PC Tang, CR Chatwin, “An automated recording system for page oriented volume holographic memories,” Review of scientific instruments 66 (11), 5174-5177, 1995
31) DM Budgett, JH Sharp, PC Tang, RCD Young, BF Scott, CR Chatwin, “Electronic compensation for non-ideal spatial light modulator characteristics,” Optical Engineering 39 (10), 2601-2608, 2000
32) P Birch, R Young, M Farsari, C Chatwin, D Budgett, “A comparison of the iterative Fourier transform method and evolutionary algorithms for the design of diffractive optical elements,” Optics and Lasers in engineering 33 (6), 439-448, 2000
33) JH Sharp, DM Budgett, TG Slack, BF Scott, “Compact phase-conjugating correlator: simulation and experimental analysis,” Applied optics 37 (20), 4380-4388, 1998
34) RCD Young, CR Chatwin, “Analysis of the maintenance of correlation plane peak localization despite severe frequency plane modulus disruption,” Optical Engineering 37 (1), 103-111,1998
35) RCD Young, CR Chatwin, “Experimental assessment of a photorefractive bandpass joint transform correlator,” OpticalEngineering 36 (10), 2754-2774, 1997
36) L Shang, RK Wang, CR Chatwin, “Frequency multiplexed DOG filter,” Optics and lasers in engineering, 27 (2), 161-177, 1997
37) RK Wang, IA Watson, C Chatwin, “Random phase encoding for optical security,” Optical Engineering 35 (9), 2464-2469, 1996

Technology Hub